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(54) Device for Automatically Clamping and Releasing Data Supports and Its Operation

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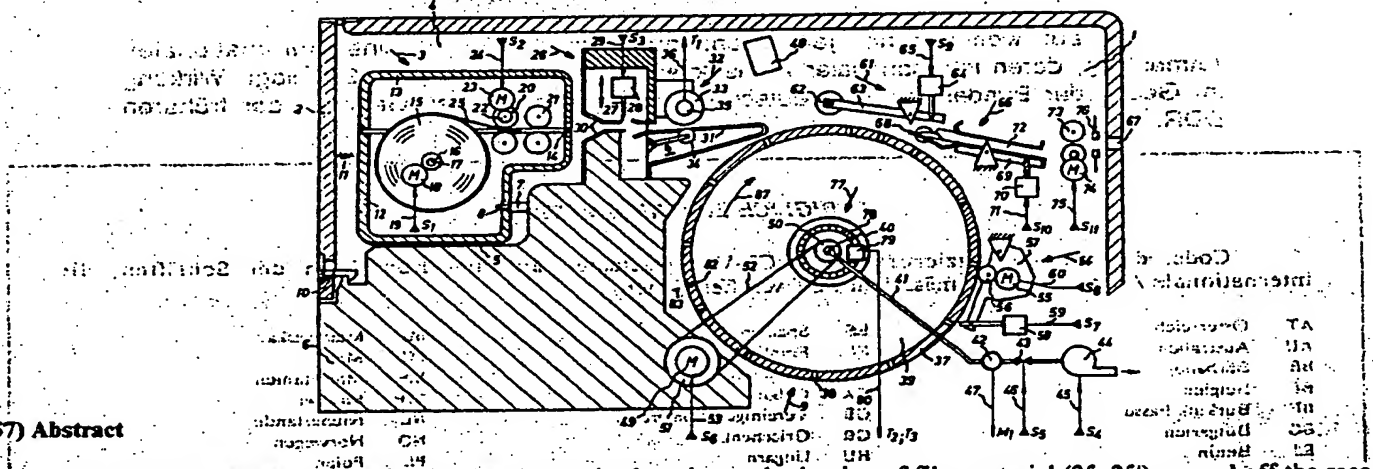

(57) Abstract

The invention relates to a device for the automatic clamping and releasing of film material (25, 25') on and off the reco ing head (9) of a reproduction device using a vacuum arrangement. The device consists of a roll-film cassette (3), a transport a guide surface (20, 21), a film cutter (26), a film-length measuring device (32), a pressur device (61) with a pressure roller (61) release device (66) with a release finger (68) and drives (22, 23, 54) to rotate the recording head (9) and transport th film mater (25, 25'). The recording head (9) has axial rows of suction apertures (38') to clamp the film material (25, 25') by means of a va um. A vacuum distributor (95, 96, 97, 98) controllable by the rotary movement is fitted in the recording head (9) and, duri clamping, successively connects the individual rows of suction apertures (38') with the fixed vacuum pump (44) so that, as the cording head (9) rotates, the film material (25, 25') is pressed against said rows (38') in stages. The device makes it possible film material of various sizes, especially large formats, to be automatically conveyed without creasing and delays and to be curely held on the recording head (9) during exposure.

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The present invention relates to the domain of electronic reproduction technology, and applies to an apparatus and the method of operation thereof, for automatically clamping film material onto the recording drum of a reproduction apparatus, for vacuum control of the recording drum, and for unclamping the film material, which has been exposed by the recording element, from the recording drum. The reproduction apparatus in question is, in particular, a colour scanner or a colour recorder.

In reproduction technology, colour separations for multi-colour printing are produced with colour scanners or colour recorders. To this end, colour signals are first generated by opto-electronic, three-colour scanning of an original colour document; these colour signals are converted into colour separation signals by means of a colour corrector. Sheets of film material, also referred to as film slips or film sheets, are clamped onto a recording drum of the colour scanner or colour recorder and then exposed, point by point and line by line, by a recording element that is modulated according to lightness by the colour separation signals. The exposed film slips are unclamped from the recording drum and developed. The developed film slips are the colour separations for multi-colour printing.

The film slips that are to be exposed are of different formats and can already be in the form of sheets of film material that are removed from a sheet film cassette in order to be clamped in

place, or else can be cut from a roll of film material, which is located in a roll film cassette, prior to being clamped into position.

In conventional colour scanners or colour recorders, the film slips that are to be exposed are clamped onto the recording drum manually, where they are then fixed in place either with an adhesive strip or by a vacuum-suction method.

In order to use a colour scanner or colour recorder effectively and economically, it is necessary to increase the degree of efficiency, in particular by reducing the preparation and adjusting times as they are compared to the time required for actual exposure of the film. The preparation and adjustment times can be reduced, for example, in that the optimal adjustment parameters for good reproduction are determined and stored by means of a work-preparation apparatus used by an operator in a preliminary process; then, immediately prior to film exposure, these parameters are transferred in a brief period of time to the colour scanner. At the same time, as many steps as possible that are normally carried out by the operator, such as, for example, clamping and unclamping the film strips onto or off the recording drum, and the vacuum installation of the film strips on the recording drum, must be automated.

In addition, it is also desirable to be able to expose film slips of various formats, in particular, large format film slips, for example for the reproduction of posters.

DE-B-22 09 515 describes an electronic reproduction apparatus with a device for clamping recording material that is in sheet form onto a recording drum using vacuum suction, and for unclamping the exposed recording material.

In the known reproduction apparatus, the film slips that are to be exposed, and which are located in a sheet-film cassette, are installed by means of a manually operated roller and lifting mechanism, with their register holes over register pins that are located on the recording drum. Then, the vacuum pump is started and the recording drum is rotated, so that the film slips are withdrawn from the sheet film cassette, wrapped around the rotating recording drum, and fixed onto the surface thereof by the vacuum. After exposure, the film slips are unclamped and moved back into the roll film cassette by the rolling and lifting mechanism.

The recording drum is a hollow cylinder and is closed off by covers. Shaft journals are secured to the covers and the recording drum is supported by these so as to be able to rotate on the equipment carrier of the reproduction apparatus. The wall of the hollow cylinder incorporates suction holes that suck the

film slips onto the surface of the drum. These suction holes are connected to the interior of the drum. One shaft journal is hollow, and this forms a suction channel that connects the interior of the drum through a rotatable fitting that is secured to the shaft journal and through a fixed suction line to a stationary vacuum pump.

The known apparatus entails the disadvantage that only film strips of a pre-set format that are provided with register holes can be clamped on and unclamped; and in that the clamping and unclamping can only be effected by an operator.

A further disadvantage of the known apparatus is the fact that when the vacuum pump is switched on at the beginning of the clamping-on procedure, all of the vacuum holes in the recording drum are acted on simultaneously by the vacuum. Because of this, there are considerable losses of vacuum, particularly when small format film slips are being used, since only a small number of the suction holes are covered by the film slip. Because of these large vacuum losses, it is impossible to ensure proper clamping of the film slips during the exposure time, during which the recording drum is rotating at high speed. The suction effect, and thus the fixing of the film slips can, of course, be improved by installing a vacuum pump with a higher nominal power rating, although this would be costly.

It is known that in order to reduce the vacuum losses, the suction holes that are not covered over by the film slip that is clamped on at a particular moment can be covered over by means of adhesive strips, or else a recording drum can be used in which the vacuum holes that are not covered are closed automatically by means of valves. The sealing of the vacuum holes by adhesive strips is time-consuming, and sealing the suction holes by means of automatically operated valves is both costly and unreliable.

It is also known that the recording drum can be divided into separately controlled vacuum chambers by means of partitions or bulkheads. In this case, it is possible to reduce the vacuum losses in that only the particular vacuum chambers that are required to fix the film strip in position, as required by the axial length of the format that is being used, are activated. In reproduction technology, there is a tendency to use unperforated roll film material and then cut off the required lengths of film from the roll film material and clamp this into position. In addition, there is a desire to be able to clamp and unclamp any formats. Practice has shown that is difficult to clamp film slips onto the recording drum precisely and without any creases, particularly in the case of large-format slips. However, the precise and smooth clamping of film strips is an indispensible prerequisite for exposing accurate colour separations and for producing high quality, multi-colour printing.

For this reason, it is the task of the present invention to describe an apparatus, together with its method of operation, for automatically clamping and unclamping perforated recording material onto and from the recording drum of a reproduction apparatus, and automatically fixing the recording material into position on the recording drum by vacuum application, by means of which reliable and smooth clamping, secure fixing by means of economical vacuum generation, and reliable unclamping of the recording material is ensured, such that a smooth working process and high quality reproduction can always be achieved.

With reference to the apparatus, this task has been solved by the features described in claim 1, and in reference to the method of operation, by the features described in patent claim 22. Advantageous developments are described in the sub-claims.

The present invention will be described in greater detail below on the basis of figures 1 to 17 appended hereto. These drawings show the following:

Figure 1: the construction principles of an apparatus for automatically clamping and unclamping recording material onto or off the recording drum of a colour recorder, in cross section;

Figure 2: the method of operation of the apparatus at the beginning of the clamping procedure, showing the recording drum in the clamping start position;

Figure 3: the method of operation of the apparatus during the clamping procedure at the time when a loop of film is being formed;

Figure 4: the method of operation of the apparatus during the clamping procedure, after a film slip has been cut from film stock;

Figure 5: the method of operation of the apparatus during the clamping procedure, when the film slip that has been cut off is being fixed into position on the recording drum;

Figure 6: the method of operation of the apparatus at the beginning of the unclamping procedure, in which the recording drum is in the unclamping start position;

Figure 7: the method of operation of the apparatus during the unclamping procedure, when the exposed film slip is being stripped from the recording drum;

Figure 8: the principles of the construction of the recording drum with a vacuum distributor for vacuum control;

Figure 9: the method of operation of the vacuum distributor at the beginning of the clamping procedure, in which the recording drum is in the clamping start position;

Figure 10: the method of operation of the vacuum distributor during the clamping procedure, at the time when the

film slip that has been cut off is being fixed in position on the recording drum;

Figure 11: the method of operation of the vacuum distributor at the end of the clamping procedure;

Figure 12: the method of operation of the vacuum distributor at the beginning of the exposure phase;

Figure 13: the method of operation of the vacuum distributor during the unclamping procedure;

Figure 14: the method of operation of the vacuum distributor at the end of the unclamping phase;

Figure 15: an example of the recording drum with the vacuum distributor;

Figure 16: the control of the valves;

Figure 17: a further example of the recording drum with a vacuum distributor.

Figure 1 is a cross sectional drawing of the construction principles of an apparatus for automatically clamping and unclamping recording material onto or from the recording drum of a colour recorder, of which only the recording drum, the dark chamber for exposure, and a part of the equipment carrier are shown.

The dark chamber 1 of the colour scanner has, on the left-hand side, a loading hatch 2 that closes so as to be light-proof. A roll film cassette 3, used as the supply cassette, is inserted

into the cassette drawer 4 of the colour recorder through the opened loading hatch 2 and installed on a platform 5 of the equipment carrier 6. With the help of centering pins 7 that are secured to the equipment carrier 6 and matching centering holes 8 in the wall of the roll film cassette 3, this is oriented precisely with reference to the equipment carrier 6 and with reference to a recording drum 9 of the colour recorder. Once the loading hatch 2 has been closed and latched by means of the latch 10, the roll film cassette 3 is pressed by the springs 11 onto the centering pins 7 and is fixed in position within the cassette drawer 4. The roll film cassette 3, which consists of a lower section 12 and a removeable light-proof cover 13, incorporates a slit-like film slot 14.

The roll film cassette 3 is charged through the opened cover 13 with a roll of film 15 of the required width, this being done outside the colour scanner, in that the hollow core of the film roll 15 is secured on a shaft 16 that is supported within the roll film cassette 3. One end of the shaft 16 passes to the outside through a drilling in the wall of the roll film cassette 3, where it is fitted with a drive wheel 17. When the roll film cassette 3 is installed in the cassette drawer 4, the drive wheel 17 is coupled to a winding motor 18 that is fixed in position on the equipment carrier 6 and controlled by means of a control signal S_1 on a wire 19. Within the roll film cassette 3, on a level with the film slot 14, there is a pair of film transport

rollers 20 and a pair of sealing rollers 21, of which, in each instance, one roll is secured to the wall of the cover 13 and the other roll is supported so as to be able to rotate on the wall of the lower part 12. The shaft end of a roll of the pair 20 of film transport rollers is led out of the roll film cassette 3 and provided with a drive wheel 22, which, when the roll film cassette is slid into position 3, is coupled with a fixed film transport motor 23. The film transport motor 23 is controlled by means of a control signal S_2 on a wire 24. The pair 21 of sealing rollers seals the cassette interior relative to the film slot 14 and renders it light-proof. The length of the pair 20 of film transport rollers, of the pair 21 of sealing rollers, and of the film slot 14 correspond to the maximum possible width of the film roll 15 which, in its turn, is determined by the design length of the recording drum 9.

When charging the roll film cassette 3, the start of the film roll 15 is threaded into the pair 20 of film transport rollers. The winding motor 18 also acts as an electric spring, in that because of its permanent excitation it generates a small counter torque to the turning moment of the film transport motor 23, so that the film stock 25 between the pair 20 of film transport rollers and the film roll 15 is under constant, light tension.

In addition, the clamping and unclamping apparatus incorporates a film cutter 26 with a cutter blade 27, which is arranged ahead of

the film slot 14 of the roll film cassette 3 and is secured to the equipment carrier 6. The cutter blade 27 is operated by a suitable activator 28 that is controlled by means of a control signal S_3 on a wire 29. The cutter blade 27 can be in the form of a drop knife that is of the width of the film stock 25, which is lowered by the activator 28, or it can be in the form of a circular blade that is guided perpendicularly to the film stock 25 by the activator 28, and cuts this stock off across its width. The film stock 25 is transported through the film cutter 26 with the help of the guide plates 30 and 31. The film cutter 26 separates the film strip of a prescribed length which is to be clamped into place and exposed at that instant from the film stock 25.

After the film cutter 26 there is a film length measuring system 32 with which the length of the film stock 25 that is moving through it is measured. The film length measuring system 32 comprises a measuring wheel 33, a spring-mounted supporting wheel 34, and an angular momentum emitter 35 that is coupled to the measuring wheel 33. The supporting wheel 34 extends through an opening in the guide plate 31 and presses the film stock 25 against the measuring wheel 33 as the stock passes through it. As the film stock 25 is being transported through the film length measuring system 32, the measuring wheel 33 rotates and this movement is transmitted to the angular momentum emitter 35. The angular momentum emitter 35 generates a series T_1 of measurement

pulses on a wire 36, and the number of these pulses is a scale for the length of the film strip 25 that is passing through.

The recording drum is a hollow cylinder 37, the face ends of which are closed off. Shaft journals are secured to the face ends and the recording drum is rotatably supported on the equipment carrier 6 by means of these; this is not shown in greater detail in figure 1. The wall of the hollow cylinder 37 incorporates suction holes 38 that are connected to a vacuum distributor, which cannot be seen in the drawing. One of the shaft journals is hollow, and this forms a vacuum channel that connects the vacuum distributor through a vacuum connector 40 to a fixed suction line 41. The suction line 41 is connected through a vacuum gauge 42 and a controllable bleed air valve 43 to a vacuum pump 44. The vacuum pump 44 is switched on and off by means of a control signal S_4 on a wire 45. A further control signal S_5 on a wire 46 activates the bleed air valve 43. The vacuum value that is measured is emitted by the vacuum gauge 42 through a wire 47 as a measurement signal M_1.

The suction holes 38 are arranged in rows that extend radially along the recording drum 9. The spacing of the rows of suction holes around the periphery is matched most expediently to the required format lengths of the film slips that are to be clamped into position, i.e., the spacing of the rows of suction holes is so selected that the beginnings and ends of the film slip of

various formats always lie in the vicinity of a row of suction holes. The precise construction of the recording drum and off the vacuum distributor, as well as its method of operation, are explained in greater detail in connection with figure 8 to figure 17.

During exposure by a recording element 48 of the film slips that have been clamped into position, the recording drum 9 is driven by a main motor 49 by way of a belt drive, this drive system consisting of a belt pulley 50 that is connected to the recording drum 9, a belt pulley 51 that is connected to the main motor 49, and a belt 52. The main motor 49 is controlled by a control signal S_6 on a wire 53.

A pivoting positioning drive 54 is incorporated in order to position the recording drum 9 when the film slips are being clamped and unclamped. The positioning drive 54 comprises a secondary motor 55 and a friction wheel 56 that is driven by the secondary motor 55. The secondary motor 55 and the friction wheel 56 are mounted on a rotatably supported carrier plate 57 and can be so positioned by means of an adjuster 58 that the friction wheel 56 either lies on the surface of the drum, as is shown in figure 1 or else is pivoted away from it. The adjuster 58 is activated by a control signal S_7 on a wire 59. The secondary motor 55 can be switched on and off by an additional control signal S_8 on a wire 60.

A contact assembly 61 is provided to press the film slips onto the recording drum 9, and this assembly is arranged in the area in which the start of the film slip that is to be clamped into position touches the surface of the drum. The contact assembly 61 consists of a contact roller 62 that is rotatably supported on an arm 63 that can pivot about a fixed point of rotation, and an adjuster 64. The adjuster 64, which is activated by a control signal S_9 on a wire 65, pivots the arm 63 such that the contact roller 62 either lies against the surface of the drum or assumes the rest position that is shown.

A similarly pivoting lift-off assembly 66 is provided to lift the exposed film slips from the recording drum 9; this assembly is arranged in the area of the dark chamber 1 in which the exposed film slips are moved from the dark chamber 1 through a film exit opening 67. The lift-off assembly 66 incorporates a lift-off finger 68 that is secured to an arm 69 that can pivot about a fixed point of rotation. The lever 69 can be so pivoted by means of an additional adjuster 70 that the lift-off finger 68 drops into a peripheral groove (which cannot be seen in the drawing) in the recording drum 9. The adjuster 70 is activated by means of a control signal S_{10} on a wire 71.

The lift-off assembly 66 also incorporates a guide channel 72 through which the exposed film slips that have been lifted off

the recording drum 9 by means of the lift-off finger 68 are passed to a pair 73 of transport rollers in the area of the film exit opening 67. This pair 73 of transport rollers, which moves the film strips from the dark chamber 1, is driven by means of a transport motor 74 that is switched on and off by a control signal S_{11} on a wire 75.

An acceptor film cassette, or the transport channel of an external film development station, can be connected to the film exit opening 67 so as to be light-proof, in order to accommodate the exposed film slips that are moved through the film exit opening 67, or to further process them.

Within the dark chamber 1, in front of the film exit opening 67, there is a light barrier 76 that monitors the transport of the exposed film slips from the dark chamber 1, and optionally starts the drive system of the external development station, and releases the clamping procedure for the next film strip.

Before the film slips are clamped into position, exposed, and unclamped, the recording drum 9 must be rotated into specific peripheral positions by means of the positioning drive 54. Such defined peripheral positions are the clamping start position, the exposure start position, and the unclamping start position. These positions will be described in greater detail in connection with the description of the method of operation of the apparatus

as based on figures 2 to 7, and a reference position of the recording drum 9.

A position sender 77 is provided in order to determine the particular peripheral position of the recording drum 9; this can consist, for example, of a raster disk 78 and a fixed opto-electronic scanner 79. By scanning the raster disk 78, the scanner 79 generates a peripheral pulse T_2 for each rotation of the recording drum 9 on a wire 80, and a running series T_3, the number of pulses of which is a measurement for the particular peripheral position of the recording drum 9.

In the reference position of the recording drum 9 a reference mark 82 that is secured to the recording drum 9 is calibrated with a fixed reference mark 83. The raster disk 78 is so adjusted that the peripheral pulse T_2 is transmitted whenever the recording drum 9 is in the reference position.

The peripheral pulse T_2 and the series T_3 of counter pulses on the wire 80, as well as the series T_1 of measurement pulses on the wire 36 and the measurement signal M_1 on the wire 47 are passed to a control circuit (not shown herein) in which all of the control signals S_1 to S_{11} are generated.

The control circuit incorporates a plurality of position counters in order to determine the clamping start position, the exposure

start position, and the unclamping start position; the series T_3 of counter pulses is passed to these and are re-set by the peripheral pulse T_2 so that the number of pulses counted at any particular moment during one rotation indicates the peripheral position of the recording drum at that time, starting from the reference position.

In addition, the control circuit contains a plurality of position memory registers in which the corresponding pulse counts for the clamping start position, the exposure start position, and the unclamping start position can be input and stored. The stored pulse counts and the pulse counts that have been input into the position counters are constantly compared to each other and, when they are equal, appropriate signals are generated so as to indicate that the particular peripheral position has been reached.

In addition, the control circuit contains a plurality of length counters, into which the sequence T_1 of measurement pulses is input from the film-length measuring system 32, and appropriate length memory registers, in which pre-set lengths are stored as pulse counts.

These stored pulse counts are once again compared with the counted pulse counts of the series T_1 of measurement pulses, in order to signal that the pre-set length has been reached.

The prescribed lengths are, in each instance, the length L_1 of the film slip that is to be cut off the film stock 25; the constant distance L_2 of the cutting point beneath the cutter blade 27 of the film cutter 26 from the measuring point beneath the measuring wheel 33 of the film-length measuring system 32 in the plane of the film stock, which is governed by the apparatus; the similarly constant distance L_3 from the measuring point to a clamping mark on the recording drum 9, when this is in the clamping position; and the length L_4 of a loop of film that is to be formed.

Now that the construction of the apparatus shown in figure 1 has been described, the method of operation of the apparatus and the individual phases of the clamping and unclamping procedure of the film slips will be described in greater detail below on the basis of figures 2 to 7.

Figure 2 shows the method of operation of the apparatus at the start of the clamping procedure, when the recording drum 9 is in a clamping start position.

Once the length L_1 of the film strip that is to be cut off from the film stock 25, or which is to be exposed at any particular moment, has been input into the appropriate length memory register of the control circuit, the recording drum 9 is first

rotated into the clamping start position with the help of the positioning drive 54 and the film stock 25 is moved as far as a clamping mark 84 on the recording drum 9.

The clamping mark 84 marks that surface line of the recording drum 9 on which the start of the film stock that is transported to the recording drum 9 is to lie. Most expediently, this clamping mark 84 is in the vicinity of a series of suction holes 38' so that in each instance the beginning area of the film stock 25 lies over the row 38' of suction holes and is sucked down onto the surface of the drum.

In the clamping start position of the recording drum 9, the clamping mark 84 covers a fixed reference mark 85. The clamping start position is so selected that the clamping mark 84 lies in the area of the contact roller 62, in which the start of the film stock 25 that is guided by the guide plate 31 to the recording drum 9 comes into contact with the surface of the drum.

In order to rotate the recording drum 9 into this clamping start position, the secondary motor 55 is started by the control signal S_8 on the wire 60; the peripheral position is determined by the position sender 77; and the secondary motor 55 is once again stopped when the clamping start position has been reached. The friction wheel 56 of the positioning drive 54 remains pivoted

into position in order to secure the recording drum 9 in the clamping start position.

Next, the film transport motor 23 is switched on by means of the control signal S_2 on the wire 24 and the film stock 25 is transported by means of the pair 22 of film transport rollers through the pair 21 of sealing rollers, through the film cutter 26 and the film-length measuring system 32, and across the guide plate 31, to the recording drum 9. When the start of the film stock 25 enters the film-length measuring system 32, this begins to measure the film length that is passing through. When the measured length of the film stock 22 is equal to the constant distance L_3 between the measuring point and the clamping mark 84 on the recording drum 9, the film transport motor 23 is stopped. Then, as is shown in figure 2, the start of the film strip 25 is at the clamping mark 84 and the start area of the film stock 25 is above the row 38' of suction holes.

Figure 3 shows the method of operation of the apparatus during the clamping procedure, at the time when a loop of film is formed.

After the film stock 25 has been transported to the clamping mark 84, the contact roller 62 of the contact assembly 61 is lowered by means of the control signal S_9 on the wire 65, whereby the start area of the film stock 25 is pressed onto the surface of

the drum. Next, the vacuum is generated by switching on the vacuum pump 44 with the control S_4 on the wire 45 and the start area of the film stock 25 is fixed on the surface of the drum by this vacuum. During this time, the bleed air valve 43 is closed so that the vacuum is effective at its full nominal value. Achievement of the full nominal value is checked with the help of the vacuum gauge 42 in that the measuring signal M_1 on the wire 47 is compared with a theoretical nominal value in the control circuit.

If, when the vacuum is measured, it is found that the nominal vacuum value has not been reached, the procedure up to this point is cancelled in that the contact roller 62 is raised, the vacuum is switched off, and the film stock 25 is transported back into the roll film cassette 3 by the film transport motor 23, until the start of the film stock 25 is in the position shown in figure 1, between the pair 22 of film transport rollers. When the film stock 25 is being spooled back into the roll film cassette 3, the winding motor 18 is started by means of the control signal S_1 on the wire 19, which once again rolls the film stock 25 that has been transported back onto the film roll 15.

If, when the vacuum is checked, it is found that the full nominal vacuum value has been reached, the formation of a loop of film 86 in the film stock 25 is started, in that the film transport motor 23 is re-started and another section of the film stock is

transported out of the roll film cassette 3. Since the start f the film stock 25 is secured by the contact roller 62 on the recording drum 9 that has been stopped in the clamping start position, the film stock 25 backs up and forms the loop 86 of film. The length of the film stock 25 that is moved through the film-length measuring system 32 as this loop is being formed is measured, and when the measured length is equal to the length L_4 of the film loop 86 that has been previously input into the control circuit, the film transport motor 23 is stopped once again. At this point in time, the film-length measuring system 32 has measured a film length $L_3 + L_4$.

Once the film loop 86 has been formed, the bleed air valve 43 is opened by the control signal S_5 on the wire 46 and the vacuum is lowered to a reduced value. This reduced vacuum is also measured by means of the vacuum gauge 42 and compared with a reduced theoretical nominal value. Should it be found that the reduced vacuum has not been reached, the procedure up to now, as described above, is once again cancelled and the film stock 25 is transported back into the roll film cassette 3.

If the reduced theoretical nominal value for the vacuum has been reached, clamping of the film stock 25, or of the film slip 25', respectively, onto the recording drum 9 is started after the cutting procedure, as is shown in figure 4.

The secondary motor 55 of the positioning drive 54 is started by the control signal S_8 on the wire 60, and the film transport motor 23 is started by the control signal S_2 on the wire 24. Because of the rotation of the recording drum 9, as is indicated by the arrow 86, the film stock 25 wraps around the recording drum 9, when the section of film stock that corresponds to the particular wrap-around is fixed on the surface of the drum by the rows of suction holes. The rotational speed of the recording drum 9 and the speed of movement of the film stock 25 are so co-ordinated that the size of the loop 86 of the film is maintained within close limits during the clamping procedure.

During the clamping procedure, the film transport motor 23 moves the film stock 25 until the film-length measuring system 32 has determined a total film length that has passed through it that corresponds to the previously input length L_1 of the film slip that is to be clamped minus the constant distance L_4 between the cutting point and the measuring point. At this point in time, the end of the film slip 25' that is to be cut off the film stock 25 is lying at the cutting point beneath the cutter blade 27 of the film cutter 26. The film transport motor 23 and the secondary motor 55 of the positioning drive 54 are stopped and the film slip 25' is separated from the film stock 25 by the cutter blade 27, by means of the control command S_3 on the wire 29.

Figure 4 shows the method of operation of the apparatus during the clamping procedure, after the film slip 25' has been cut from the film stock 25.

After the film has been cut, the film transport motor 23 runs in the reverse direction and moves the film stock 25 back into the roll film cassette until the cut edge lies between the pair 22 of film transport rolls, whereupon the film stock 25 is ready for another clamping procedure.

Once the film has been cut, the secondary motor 55 of the positioning drive 54 once again starts and the recording drum 9 rotates once again in the direction indicated by the arrow 87 in order to clamp the whole of the film slip 25', whereupon the clamped film slip 25' is fixed in position on the surface of the drum by the reduced vacuum.

Because of the loop 86 of film, the film transport is de-coupled from the rotary movement of the recording drum 9 whereby, in an advantageous manner, it is possible to avoid tumbling errors in the roll film cassette, crooked clamping of the film slip 25' on the recording drum 9, as well as distortion and creasing within the film slip 25'. In addition, there is the fact that because of the loop 86 of film, the starting area of the film slip 25' is stiffened and this ensures proper fixing of the start area. The tendency of the film slip to crease and become distorted is

further reduced by reducing the vacuum during the clamping procedure, and at the same time clamping without tension is ensured.

Figure 5 shows the method of operation of the apparatus during the clamping procedure, when the film slip 25' that has been cut off is being fixed into position on the recording drum 9.

If the recording drum 9 is in the exposure start position, the secondary motor 55 of the positioning drive 54 is stopped. In the exposure start position, the clamp mark 84 on the recording drum 9 is on the optical axis 88 of the recording element 48. In the exposure start position of the recording drum 9, the friction wheel 56 of the positioning drive 54 and the contact roller 62 of the contact system 61 are raised from the surface of the recording drum 9 by the control signals S_8 and S_9 on the wires 60 and 65. Simultaneously, the vacuum is increased to the full nominal value by the bleed air valve 43 being closed by means of the control signal S_5 on the wire 46. If vacuum monitoring by means of the vacuum gauge 42 indicates that the nominal value has actually been achieved, the main motor 49 is started by the control signal S_6 on the wire 53 and this rotates the recording drum 9 during the exposure of the clamped film slip 25' by the recording element 48.

Figure 6 shows the operation of the apparatus at the beginning of the unclamping procedure, with the recording drum 9 in an unclamping start position.

After exposure of the film slip 25' and after the recording drum 9 has been braked to a standstill, the unclamping procedure is initiated. The friction wheel 56 of the positioning drive 54 is once again lowered to the surface of the recording drum 9 by the control command S_7 on the wire 59; the secondary motor 55 of the positioning drive 54 is switched on by the control signal S_8 on the wire 60; and the recording drum 9 is rotated into the unclamping start position, in the direction indicated by the arrow 87. In the unclamping start position, a fixed unclamp mark 90 on the recording drum 9 is located below the tip of the lift-off finger 68 of the lift-off assembly 66. The unclamp mark 90 lies in the area of the drum surface that may not be covered by the clamped-on film slip 25', in order that the lift-off finger 68 can drop into the peripheral groove (not shown herein) in the recording drum 9 between the start and end of the clamped film slip 25'. This results in the requirement that the greatest possible length of a film slip 25' that is to clamped must be shorter than the peripheral length of the recording drum 9 by the amount quoted. The unclamping start position is assumed regardless of the particular length of the film slip 25' that has been clamped.

In the unclamping start position, the contact roller 62 of the contact assembly 61 is lowered by the control signal S_9 on the wire 65, and the lift-off finger of the lift-off assembly 71 is lowered, and the transport motor 74 is started by the control signal S_{11} on the wire 75 so that the pair 73 of film transport rolls are caused to rotate. After this, the secondary motor 55 of the positioning drive 54 is once again started by the control signal S_8 on the wire 60, and the recording drum is rotated further in the direction indicated by the arrow 87.

Figure 7 shows the method of operation of the apparatus during the unclamping procedure, when the exposed film slip 25' is being stripped off the recording drum 9.

Because of the rotation of the drum 9, the lift-off finger 68 strips the film slip 25' that has been exposed from the surface of the drum under a full vacuum. Because of the rotation of the recording drum 9, the exposed film slip 25' is slid through the guide channel 22 of the lift-off assembly 66 until it is gripped by the pair 73 of transport rollers and transported out of the dark chamber 1 through the film exit opening 67.

The transport motor 74 is fitted with an idling or free wheel device, which means that, in an advantageous manner, the speed of rotation of the recording drum 9 and the rotational movement of

the pair 73 of film transport rollers can be matched to each other.

Now that the apparatus for clamping and unclamping the film material, together with its method of operation, have been described, the construction of the recording drum 9 and of the vacuum distributor, as well as the method of operation of these, will be described.

Figure 8 shows the construction principles of the recording drum 9 with the vacuum distributor that is used for controlling the vacuum, in cross section. The wall 93 of the recording drum 9 that is configured as a hollow cylinder 37 incorporates suction holes 38 that are arranged in rows 38' that extend axially to the axis of the drum. The suction holes 38 of the individual rows 38' of suction holes open out into suction channels 94 that extend axially to the axis of the drum in the wall 93.

The recording drum 9 incorporates a vacuum distributor that applies a vacuum sequentially to the individual rows 38' of suction holes, depending on the particular angle of rotation of the recording drum 9 or on the size of the loop of the film stock 25' around the recording drum 9 at any particular moment, and only connects up as many rows 38' of suction holes as are affected by the length of the wrap-around of the film slip 25' that is on the drum at that moment.

Precise and crease-free clamping, in particular of large format film slips, and, because of the small vacuum losses, reliable fixing of the film slip 25' on the surface of the drum during exposure is achieved by this incremental connection of the rows 38' of suction holes according to the particular wrap-around of film slip 25'.

The vacuum distributor consists essentially of a vacuum chamber 95, distributor lines 96, valves 97, and of a control disk 98 for the valves 97.

The cylindrical vacuum chamber 95, which is located in the interior of the drum, is connected to the individual suction channels 94 or rows 38' of suction holes through the distributor lines 96 that extend radially to the axis of the drum. Within the distributor lines 96, the valves 97 are arranged in a circle about the axis of the drum, and these valves connect the individual suction channels to the vacuum chamber 95 or separate them from it, as selected. The vacuum chamber 95 is connected through a suction drilling 99 in the shaft journal 100 to a vacuum pump 44 (not shown herein).

In the embodiment shown, the valves 97 are controlled mechanically by the control disk 98. As an alternative to this, pneumatically or electrically controllable valves can be used.

The control disk 98, which incorporates a control finger 101 and a groove 102 in its periphery, is a sliding fit on the shaft journal 100. A locking pin 104 can be introduced into the groove 102 of the control disk 98 by means of a fixed activator 103 and this locks the control disk 98 in a specific position. Then, as the recording drum 9 is rotated, the valves 97 move past the control finger 101 of the locked control disk 98, which then opens or closes the valves one after the other, depending on the rotation of the recording drum 9, in which case the valves 97 stay in the working position that they assume in each instance.

The particular working position of the valves 97 is indicated by the dashes 105; dash 105 that extends in the direction of a distributor line 96 indicates an open valve 97, and a dash 105 that is perpendicular to a distributor line 96 indicates a closed valve 97. The sliding fit with which the control disk 98 is supported on the shaft journal 100 is such that the shaft journal 100 rotates without any notable friction when the control disk 98 is blocked and, on the other hand, it takes the control disk 98 with it in the position relative to the recording drum 9 that it assumes when it is released by the locking pin 104, in which connection no further valves 97 are operated during continued rotation of the drum.

The operation of the vacuum distributor will now be described in greater detail on the basis of figures 9 to 14.

Figure 9 shows the start of the clamping procedure for a film slip 25', in which the recording drum 9 that is shown in cross section is in the clamping start position.

When the recording drum 9 is in the clamping start position, the clamp mark 84 lies in the vicinity of the contact roller 62 in which the start of the film slip 25' that is to be transported to the recording drum 9 is in contact with the surface of the drum.

The recording drum 9 has been rotated into the clamping start position by the friction wheel 56 of the positioning drive 57 that has been pivoted onto the surface of the drum, in which the recording drum 9 initially stays because the positioning drive 57 is switched off.

The control disk 98 is blocked in the position for the clamping start position of the recording drum by the locking pin 104, in which the control finger 101 opens the valve 97a. Because of this, the vacuum is applied only to the suction channel 94a that is in the vicinity of the clamping mark 84 when the vacuum pump 44 is switched on, and the start section of the film slip 25' that is to be clamped into position is fixed on the surface of the drum by the associated row 38'a of suction holes.

Because of the fact that, at this point in time, only the row 38'a of suction holes that is associated with the suction channel 94a is acted on by the vacuum, the vacuum is effective at this point at its full nominal value because of which, in an advantageous manner, any slipping of the start section of the film slip 25' from its exact position in the initial phase of the film clamping procedure is avoided.

Once the starting section of the film slip 25' is fixed in position on the row 38'a of suction holes, the positioning drive 57 is switched on once again and the recording drum 9 is rotated from the clamping start position in the direction indicated by the arrow 87, which means that the film slip 25' is pulled from the film transport surface 31 and wrapped even further around the rotating recording drum 9.

Figure 10 shows the clamping procedure at a later stage, in which the valves 97b and 97c are moved past the control finger 101 of the blocked control disk 98 by rotation of the recording drum 9 in the direction indicated by the arrow 87. These valves are then opened, so that now, in addition, the rows 38'b and 38'c of suction holes are acted upon by the vacuum, depending on the extent to which the film slip 25' is wrapped around the recording drum 9 at that moment.

Figure 11 shows the clamping procedure at the time when the film slip 25' is already fully clamped because of the rotation of the recording drum 9 in the direction indicated by the arrow 87 and by the incremental connection of the rows 38'b and 38'c of suction holes that are associated with the suction channels 94b to 94f.

The clamping procedure is greatly improved by the incremental closing of the rows 38' of suction holes. Because the full value of the vacuum is only effective on the rows 38' of suction holes that are connected in each instance, on which the film slip 25' and the surface of the drum are in contact at that moment, and the free end of the film slip 25' is not yet held in position, it can centre itself freely during the clamping procedure, whereby a precise and crease-free clamping, in particular of longer film slips, is ensured in an advantageous manner. The clamping procedure can be further improved in that the nominal value of the vacuum is reduced during the clamping procedure by opening the bleed air valve 43.

Once the film slip 25' has been completely clamped, the contact roller 62 is raised from the surface of the drum and the locking pin 104 is withdrawn from the groove 102 in the control disk 98 by the activator 103, which means that the blocking of the control disk 98 is released. On further rotation of the recording drum 9, the control disk 98 rotates with the recording

drum 9, and moves into the position relativ to the recording drum 9 that it occupies when the control disk 98 is freed. Thus, there is no more relative movement between the valves 97 and the control finger 101 of the control disk 98, no more valves 97 are opened, and no further rows 38' of suction holes are connected.

This means that, in each instance, the vacuum is applied to only as many rows 38' of suction holes that are actually covered around the periphery by the film slip 25' that is clamped at a particular moment, in which connection the remaining rows 38' of suction holes are disconnected. Because of this, as a result of the smaller vacuum losses, it is always possible to ensure the secure fixing of the film slips 25' of different formats on the recording drum 9, in particular in the exposure phase, during which the recording drum is rotating at a high speed.

The switching signal for the activator 103, with which the blocking of the control disk 98 is released when film slips 25' of a different format are completely clamped, can be generated automatically.

To this end, for example, a pulse generator is coupled to the recording drum 9, and this generates a series of pulses when the recording drum 9 is rotated. The number of pulses counted from the clamping start position of the recording drum 9 onwards is a measurement for the particular angle of rotation of the recording

drum 9 at any particular time and for the length of the film slip 25' that has been clamped. The particular format length of the film slip 25' that is to be clamped is set as a number of pulses. Pulses from the pulse generator that are counted are then compared constantly with the given number of pulses and when these are equal the switching signal for the activator 103 is generated.

Figure 12 shows the recording drum 9 at the time at which it has been rotated into the exposure start position by means of the positioning drive 57, and the positioning drive 57 is switched off. In the exposure start position, the start mark 84 on the recording drum is over the optical axis 88 of the recording element 48.

It can be seen from this figure that no additional suction holes 38' are switched on by the rotation of the recording drum 9 into the exposure start position, because the control finger 101 of the control disk 98 remains at valve 97f.

The unclamping procedure for the exposed film slip 25' from the recording drum 9 takes place after exposure.

Figure 13 shows the recording drum 9 after the exposed film slip 25' has been unclamped. At this time, the valves 97a to 97f that were previously opened during the unclamping procedure are still

op n and must be closed in order to prepare for a new clamping procedure.

To this end, the positioning drive 57 is once again tilted onto the recording drum 9 and started. The recording drum 9 rotates together with the control disk 98 in the direction indicated by the arrow 107, in the reverse direction of the direction during the clamping procedure. Because of a switching signal on the activator 103, the locking pin 104 is moved towards the control disk 98. The locking pin 104 first slides on the edge of the rotating control disk 98 until it drops into the groove 102 and blocks the control disk 98.

As a result of continued rotation of the recording drum 9 in the direction indicated by the arrow 107, the valves 97f to 97a move in sequence past the control finger 101 of the blocked control disk 98 and are closed by the control finger 101. This status is shown in figure 14.

In the event that the unclamping of the exposed film slips is to be effected by the vacuum on the individual rows of suction holes being switched off incrementally, the recording drum 9 rotates in the direction indicated by the arrow 87.

Figure 15 shows a practical embodiment for the vacuum distributor in longitudinal cross section through the recording drum 9 that is configured as a hollow cylinder.

Two of the suction channels 94 can be seen in the wall 93 of the hollow cylinder 39, and these are connected to the suction holes 38. The face surface of the hollow cylinder 38 is closed by means of a cover 108 that incorporates a central opening 100. The inside of the cover 108 incorporates radial grooves 110 that are connected to the suction channels 94. The outside of the cover 108 incorporates drillings 111 that are arranged in a circle around the axis of the drum and open out into the radial grooves 110. The drillings 111 accommodate the bodies 112 of the valves 97. Within the body 112 of the valve 97 there is a tappet 113 that has at one end a circular sealing surface 114 and at its other end a control roll 115.

Within the hollow cylinder 39 there is a cylindrical housing section 116, and an extension 117 of this fits in the opening 109 of the cover 108. The peripheral surface 118 of the housing section 116 is hermetically joined to the inner surface of the hollow cylinder 39, and the face 119 of the housing section 116 is hermetically joined to the inner surface of the cover 108. The grooves 110 in the cover 108 that are hermetically covered off by the face 119 of the housing section 116 form the distributor lines 96. The shaft journal 100 is secured to the

extension 117 of the housing section 116. The interior of the housing section 116 forms the vacuum chamber 95 that is connected through the suction drilling 99 in the housing section 116 to the suction drilling 99 in the shaft journal 100. On its face, the housing section 116 incorporates drillings 120 that are arranged in a circle around the axis of the shaft, which are opposite the valves 47, and which can be closed by the sealing surfaces 114 of the valves 97. The control disk 98 is supported on the extension 121 of the shaft journal 100 by means of a disk 122 so as to form a sliding fit. The groove 102, into which the locking pin 104 can be introduced, can be seen on the control disk 98.

In figure 15, the upper valve 97 has been opened by the control finger 101 of the control disk 98 in that the sealing surface 114 releases the associated drilling 120 by which means the connection is formed through the drilling 120 and the distributor line 96 between the vacuum chamber 95 and the upper suction channel 94. In contrast to this, the lower valve 97 is closed, in that the sealing surface 114 of the valve 97 is pressed against the associated drilling 120 by means of a spring 123, which means that the connection between the vacuum chamber 95 and the lower suction channel 94 has been interrupted. The valve 97 has a stable working position in the closed state because of the spring 123. Control of the valve 97 by the control disk 98 is shown in greater detail in figure 16.

In addition, the housing section 116 can incorporate a choke drilling 124 that connects the vacuum chamber 95 with the interior of the drum. When the vacuum chamber 95 is evacuated, the vacuum gradually builds up in the interior of the drum through the choke drilling 124, and this then serves as a vacuum reservoir. The vacuum reservoir acts in such a way that the vacuum at the suction holes 38 only breaks down slowly when the vacuum pump is switched off.

Figure 16 shows the control of the valves 97 by means of the control disk 98. The control finger 101 of the control disk 98, which up to now has only been indicated diagrammatically, is configured as a "switch" for the control roll 115 of the valve 97.

In figure 16a, the control roll 115 of the valve 97 has not yet reached the control finger 101 of the control disk 98. The valve 97 remains in the 'closed' stable working position, in which the sealing surface 114 closes off the drilling 120.

In figure 16b, the control roll 115 of the valve 97 has been engaged by the movement of the valve 97 in the direction indicated by the arrow 125 by the control finger 101 of the control disk 98 and moved onto the control disk 98, which means that the tappet 113 of the valve 97 completes a lifting movement. Because of this lifting movement of the tappet 113, the valve 97

assumes the "open" working position, in which the sealing surface 114 opens the drilling 120.

Because of the fact that the control roll 115 now rolls on the control disk 98, the valve 97 remains fixed in the "open" working position. Because of a relative movement in the opposite direction, the control roll 115 of the valve 97 can be moved into the stable "closed" working position by the control finger 101.

Figure 17 shows a further embodiment for the clamping apparatus, in which the recording drum 1 is divided by means of the bulkheads 126 in the suction channels 94 into two axially adjacent vacuum zones 127 and 128, to which a vacuum can be applied separately.

Both vacuum zones 127 and 128 can be controlled by separated vacuum distributors 129 and 130. The vacuum chamber 95 of the vacuum distributor 130 is connected through the suction drilling 99 in the shaft journal 100 to the vacuum pump 44, as is shown and described in figure 17. In contrast to this, the vacuum chamber 95' of the vacuum distributor 129 is evacuated through a pipe 131 from the vacuum chamber 95 of the vacuum distributor 130.

Both vacuum zones 127 and 128 are separately controlled by the control disks 98 and 98', by which means the vacuum losses can be

kept very small even in the case of different format widths of the film slips that are to be clamped.

If a film slip that is of a smaller format width than the width of a vacuum zone is to be clamped, only one vacuum zone is activated. The other vacuum zone then remains unconnected in that the control disk of the particular vacuum zone is not blocked during the clamping procedure, which means that no valves are opened.

If two film slips of small format width but of equal format length, or one film slip is to be clamped, this has a format width that is greater than the width of a vacuum zone, both vacuum zones are activated and the automatic connection of the rows of suction holes is synchronized.

In the event that two film slips of narrower format width but of different format lengths are to be clamped, in an advantageous manner, the connection of the rows of suction holes can be controlled separately, according to the particular format length in the two vacuum zones.

PATENT CLAIMS

1. An apparatus for automatically clamping film material onto a recording drum of a recording apparatus and for unclamping the film material that has been exposed by a recording element from the recording drum, in which the recording drum (9) is located in a light-proof chamber (1) of the reproducing apparatus, the surface of the recording drum (9) incorporates suction holes (38') for the vacuum fixing of the film material (25'), said holes being arranged in rows (38') of suction holes that extend axially to the axis of the drum, and in which the rows (38') of suction holes can be connected to a fixed vacuum pump (44), characterized by

- a roll film cassette (3) that contains the film material in the form of a rotatable film roll (15) and which is provided with a film slot (14) that can be closed so as to be light-proof, this being installable in the light-proof chamber (1) and there locked into position, the film slot (14) facing the recording drum (9) and extending axially to this;
- a transport and guide plate (30; 31) that is arranged between the film slot (14) of the roll film cassette (3) and the recording drum (9), which in the area of the recording drum (9) runs essentially tangentially to this, for the film stock (25) that is wound off the film roll (15);

- film transport means (22; 23) to transport the film stock (25) from the roll film cassette (3) and to the recording drum (9);
- a film cutter (26) that is arranged between the roll film cassette (3) and the recording drum (9) in order to separate a film sheet (25') that is to be exposed and which is of the prescribed length from the film stock (25);
- a film-length measuring system (32) that is arranged between the roll film cassette (3) and the recording drum (9) that is used to determine the length of the film stock (25) that passes through it on each occasion;
- a contact assembly (61) with a contact roll (62) that can be pivoted into the area on the recording drum (9) in which the start of the film stock (25) that has been transported over the transport and guide plates (30; 31) to the recording drum (9) comes into contact with the surface of the drum;
- a positioning drive (54) to rotate the recording drum (9) into a clamping start position, an exposure start position, and an unclamping start position;
- a lift-off assembly (66) with a lift-off finger (68) that can be pivoted onto the recording drum (9) in order to strip the exposed film sheet off the recording drum (9);

- suction channels (94) in the recording drum (9) that extend axially to the axis of the drum, each of which connects the suction holes (38) of a row (38') of suction holes with each other, and a vacuum distributor (95; 96; 97; 98) that is controllable by the rotational movement of the recording drum (9), which connects the individual suction channels (94) with the fixed vacuum pump (44) through a suction line (41), the vacuum distributor (95; 96; 97; 98) being controllable in such a way that during the clamping procedure, first the row (38) of suction holes on which the start section of the film sheet (25') is lying is acted upon by the vacuum, and then additional rows (38') of suction holes are switched on one after the other in keeping with the growing wrap-around of film sheet (25') that is formed around the recording drum (9), these then being acted upon by the vacuum, and the connection of additional rows (38') of suction holes being ended at those rows (38') of suction holes on which the end section of the film sheet (25') is lying, according to the particular wrap-around length of the film sheet (25') that is to be clamped.

2. An apparatus as defined in claim 1, characterized in that a controllable bleed-air valve (43) is incorporated in the

suction line (41) in order to reduce the vacuum during the clamping and/or unclamping of the film material.

3. An apparatus as defined in claim 1 or claim 2, characterized in that the roll film cassette (3) incorporates sealing rolls (21) that are arranged above and below the film stock (25) in order to provide a light seal in the area of the film slot (14), the length of these rolls corresponding at least to the length of the film slot (14).

4. An apparatus as defined in one of the claims 1 to 3, characterized in that

- the film transport means (22; 23) consist of transport rollers (22) that are arranged above and below the film stock (25) in the roll film cassette (3), at least one of these being driveable by a film transport motor (23);
- the film transport motor (23) is fixed immovably to the equipment carrier (6) of the reproduction apparatus;
- the driven transport roller (22) can be connected to the film transport motor (23) through the wall of the roll film cassette (3).

5. An apparatus as defined in one of the claims 1 to 4, characterized in that the shaft (16) of the film roll (15) in the roll film cassette (3) can be coupled with a winding motor (18) in order to transport film stock (25) that has

been wound off back into the roll film cassette (3), should this be necessary, and wind it onto the film roll (15).

6. An apparatus as defined in one of the claims 1 to 5, characterized in that a counter torque moment to the torque of the film transport motor (23) can be generated by the constant excitation of the winding motor (18) in order to tension the film stock (25) between the film roll (15) and the transport rolls (22).

7. An apparatus as defined in one of the claims 1 to 6, characterized in that

- the roll film cassette (3) consists of a lower part (12) and a removeable cover (13) that can be closed so as to be light-proof;
- one roll of the pair (21) of sealing rolls and one roll of the pair (22) of the transport rolls is supported in the lower part (12) of the roll film cassette (3) and each of the other rolls is supported in the cover (13).

8. An apparatus as defined in one of the claims 1 to 7, characterized in that

- the light-proof space (1) of the reproduction apparatus incorporates a loading hatch (2) for installing the roll film cassette (3), this loading hatch being closeable so as to be light-tight and latchable;

- the equipment carrier (6) incorporates a platform (5) for accommodating the roll film cassette (3) within the light-proof space (1);
- means (7; 8; 11) to orient the roll film cassette (3) with reference to the recording drum (9) and to lock the roll film cassette (3) to the equipment carrier (6).

9. An apparatus as defined in one of the claims 1 to 8, characterized in that the film cutter (26) for the film stock (25) is configured as a circular blade that can be rolled along the line of the cut transversely to the film stock (25).

10. An apparatus as defined in one of the claims 1 to 9, characterized in that the film-length measuring system (32) consists of a measuring wheel (33) that is driven by the movement of the film stock (25), a supporting wheel (34) that holds the film stock against the measuring wheel by spring action, and of a angular momentum emitter (35) that is coupled to the measuring wheel (33) and which converts the rotation of the measuring wheel (33) into a series of pulses, the number of pulses being a scale for the film length that is measured.

11. An apparatus as defined in one of the claims 1 to 10, characterized in that

- the light-proof chamber (1) incorporates a slot-like film exit opening (67) for the exposed film sheets in the vicinity of the lift-off assembly (66);
- the lift-off assembly (66) incorporates a film guide channel (72) that leads in the direction of the film exit opening (67) when the lift-off finger (68) is pivoted onto the recording drum (9);
- a further driven pair (73) of film transport rolls is incorporated between the lift-off assembly (66) and the film exit opening (67), so as to transport the exposed film sheets from the light-proof chamber (1) through the film exit openings (67).

12. An apparatus as defined in one of the claims 1 to 11, characterized in that a take-up cassette to accommodate the exposed film sheets can be connected to the film exit opening (67) of the light-proof chamber (1) in such a way as to be light-proof.

13. An apparatus as defined in one of the claims 1 to 12, characterized in that the film transport channel of a film-developing station can be connected to the film exit opening (67) of the light-proof chamber (1) in such a way as to be light-proof.

14. An apparatus as defined in one of the claims 1 to 13, characterized in that a vacuum gauge (42) is incorporated in the suction line (41), said gauge generating an electrical measurement signal for monitoring the vacuum.

15. An apparatus as defined in one of the claims 1 to 14, characterized in that the vacuum distributor (95; 96; 97; 98) incorporates the following components:

- a vacuum chamber (95) within the recording drum (9), which is connected through a shaft journal (100), the recording drum (9), to the fixed vacuum pump (94);
- distributor lines (96) between the vacuum chamber (45) and the individual suction channels (94) that extend essentially radially to the axis of the drum;
- controllable valves (97) in the distributor lines (96) to open and close selected distributor lines (96);
- means (98; 101; 102; 103; 104) to control the valves (97) as a function of the rotary movement of the recording drum (9).

16. An apparatus as defined in claim 15, characterized in that the means (98; 101; 102; 103; 104) for controlling the valves (97) consist of the following components:

- a control disk (98) that is supported on the shaft journal (100) of the recording drum (9) with a control finger (101) as the activating element to open and close the valves (97) that are arranged in a circle about the control disk (98);
- a locking system (102; 103; 104) to lock the control disk (98) in a prescribed fixed position of the recording drum (9), the control disk (98) being

supported as a sliding fit on the shaft journal (100) in such a way that the control disk (98) that is not locked by the locking system (102; 103; 104) is moved by the shaft journal (100) of the rotating recording drum (9) without any slippage.

17. An apparatus as defined in claim 16, characterized in that the locking system (102; 103; 104) consists of an adjustable locking pin (104) that can be moved by a fixed activator (103) and that engages in a groove (102) located on the control disk (98).

18. An apparatus as defined in one of the claims 15 to 17, characterized in that the valves (97) are controllable in the "open" working position by activation of a control roll (115) that is secured to a tappet (113) by the control finger (101) of the control disk (98), the valves (97) assuming their stable "closed" working position without activation of the control roll (115) by the control finger (101).

19. An apparatus as defined in one of the claims 1 to 18, characterized in that

- the recording drum (9) is configured as a hollow cylinder (37) in the wall (93) of which the suction channels (94) run, and the face sides of which are closed off by disk-shaped covers (108) of which at least one incorporates a central opening (108);

- the inner surface of the cover (108) that faces the interior of the drum incorporates grooves (110) that run essentially radially;
- the outer surface of the cover (108) is provided with drillings (111) that are arranged in a circle about the axis of the drum and open into the grooves (110) and in which the valves (97) are installed;
- a cylindrical housing section (110) on the inside surface of the cover (108) which is secured by its extension (117) in the central opening (109) of the cover (108), the grooves (110) in the cover (108), which are covered so as to be air-tight, forming distributor lines (96) that are connected with the suction channels (44);
- a shaft journal (100) is secured on the extension (117) of the housing section (116) that extends through the opening (109) in the cover (108), said journal incorporating the suction drilling (99');
- the interior of the housing section (116) forms the vacuum chamber (95) that is connected through the suction drilling (99') in the housing section (116) with the suction drilling (99) in the shaft journal (100);
- the face side of the housing section (116) that faces towards the cover (108) incorporates drillings (110) arranged in a circle, which connect the vacuum

chamber (95) with the grooves (110) and which are so arranged that they can be closed by the valves (97);

- the control disk (98) is supported by means of a disk (122) on the extension (121) of the shaft journal (100).

20. An apparatus as defined in one of the claims 1 to 19, characterized in that the suction channels (94) in the recording drum (9) incorporate bulkheads (126) which divide the recording drum (9) into two separate vacuum zones (127; 128);

- a separately controllable vacuum distributor (128; 130) is associated with each vacuum zone (127; 128).

21. An apparatus as defined in claim 20, characterized in that the vacuum chamber (95') of one vacuum distributor (129) is connected with the vacuum chamber (95) of the other vacuum distributor (130) through a pipe (131) that extends axially in the interior of the drum.

22. The method of operation of the apparatus for automatically clamping film material on the recording drum of a reproduction apparatus and for unclamping film material that has been exposed by a recording element from the recording drum, in which

- the recording drum (9) is arranged within a light-proof chamber (1) of the reproduction apparatus;
- the surface of the recording drum (9) incorporates suction holes (38) that are arranged in rows (38') of

suction holes that are arranged axially to the axis of the drum;

- the rows (38') of suction holes are connected to the vacuum pump (44) through a suction line (41), in order to fix the film material (25') to the recording drum (9), characterized in that
  - the recording drum (9) is rotated into the clamping start position by means of the positioning drive (54); the film transport means (22; 23) are started, and the film strip (25) is wound off from the film roll (15) of the roll film cassette (3) and moved over the transport and guide plates (30; 31) to the recording drum (9);
  - the film transport means (22; 23) are stopped, when the start of the transported film stock (25) lies in the clamping start position in the vicinity of the contact roll (62) of the contact assembly (61) and in the vicinity of a row (38') of suction holes on the recording drum (9);
  - the contact roll (62) of the contact assembly (61) is lowered onto the recording drum (9) in order to press the start of the film strip (25) onto the recording drum (9);
  - the first row (38') of suction holes is acted upon by the vacuum through the vacuum distributor (95;

96; 97; 98) and the start section of the film strip (25) is sucked down;

- the film transport means (22; 23) and the positioning drive (54) are started so as to rotate the recording drum (9), and additional film stock (25) is transported to the recording drum (9);
- during the rotation of the drum, additional rows (38') of suction holes are connected in series by the growing loop of film strip material (25) around the rotating recording drum (9) by the vacuum distributor (95; 96; 97; 98) and acted upon by the vacuum, and the film stock (25) is fixed in position on the recording drum (9) by the vacuum;
- the film sheet (25) that is clamped into position is exposed point by point and line by line by the recording element (48);
- after exposure, the recording drum (9) is rotated by the positioning drive (54) into the unclamping start position, in the unclamping start position the contact roller (62) of the contact assembly (61) and the lift-off finger (68) of the lift-off assembly (66) are lowered onto the recording drum (9);
- the exposed film sheet (25') is stripped off from the surface of the drum by means of the lowered

lift-off fingers (68), as a result of rotation of the recording drum (9);

- the rows (38') to which vacuum is applied when the film sheet (25') is being clamped are disconnected once again by the vacuum distributor (95; 96; 97; 98) and the recording drum is rotated into the clamping start position;
- during the clamping of the film stock (25) the film stock length is measured in the film-length measuring system (32) and the film transport means (22; 23) and the positioning drive (54) are stopped when the end of the film sheet (25') of a prescribed length that is to be cut from the film stock (25) lies under the film cutter (26);
- the film sheet (25') is cut off from the film stock (25) by the film cutter (26); and the remaining part of the film sheet (25') is clamped into position by the step by step activation of additional rows (38') of suction holes by the vacuum distributor (95; 96; 97; 98);
- the activation of additional rows (38') of suction holes by the vacuum distributor (95; 96; 97; 98) according to the particular peripheral length of the film sheet (25') is ended at that row (38') of suction holes on which the end section of the film sheet (25') lies, and then the contact roll (62)

of the contact assembly (61) is raised from the recording drum (9).

23. The method of operation of the apparatus as defined in claim 22, characterized in that

- after the start of the film stock (25) has been fixed in position on the recording drum (9), only the film transport means (22; 23) are started and a loop of film of a prescribed length is formed by the movement of additional film stock (25) from the roll film cassette (3), this being done in the starting section of the film stock (25);
- after formation of the film loop (86) the positioning drive (54) is started to rotate the recording drum (9) and extra film stock (25) is moved to the recording drum (9) and clamped on whilst the loop (86) of film that has been formed is maintained.

24. The method of operation of the apparatus according to claim 22 or claim 23, characterized in that the nominal value of the vacuum that is foreseen for the exposure phase is lowered for the duration of the clamping phase by opening the bleed air valve (43), which means the film sheet (25) is sucked into position under a reduced vacuum.

25. The method of operation of the apparatus according to one of the claims 22 to 24, characterized in that the actual value and the reduced actual value for the vacuum are measured by means of a vacuum gauge (42), the measured actual value is

compared with nominal values, and in the event that the measured actual value does not reach the nominal value, the previously completed processes are cancelled and the film stock is transported back into the roll film cassette (3).

26. The method of operation of the apparatus as defined in one of the claims 22 to 25, characterized in that the length of the film stock (25), which passes through the film-length measuring system (32) is measured, and the measured film length is compared with the constant distance between the film-length measuring apparatus (32) and the clamping mark (84) in the clamping start position of the recording drum (9); and in that the film transport means (22; 23) are stopped when these are equal, the start of the film stock (25) then being located on the clamp mark (84).

27. The method of operation of the apparatus according to one of the claims 22 to 26, characterized in that the length of the additional film stock (25) that is transported is measured in the film-length measuring system (32) and the measured film length is compared with a pre-set length for the film loop (86); and in that when these are equal, the film transport means (22; 23) are stopped.

28. The method of operation of the apparatus according to one of the claims 22 to 27, characterized in that during the clamping of the film stock (25), the measurement of the film stock length in the film-length measuring system (32), proceeding from the previously measured film length, is

continued and the film length that is measured at a particular moment is compared with the prescribed length for the film sheet (25') that is to be clamped on each occasion, taking into account the constant distance between the film measuring system (32) and the film cutter (26); and in that when these are equal, the film transport means (22; 23) and the positioning drive (54) are stopped, the end of the film sheet (25') that is to be cut off the film stock (25) lying under the film cutter (26).

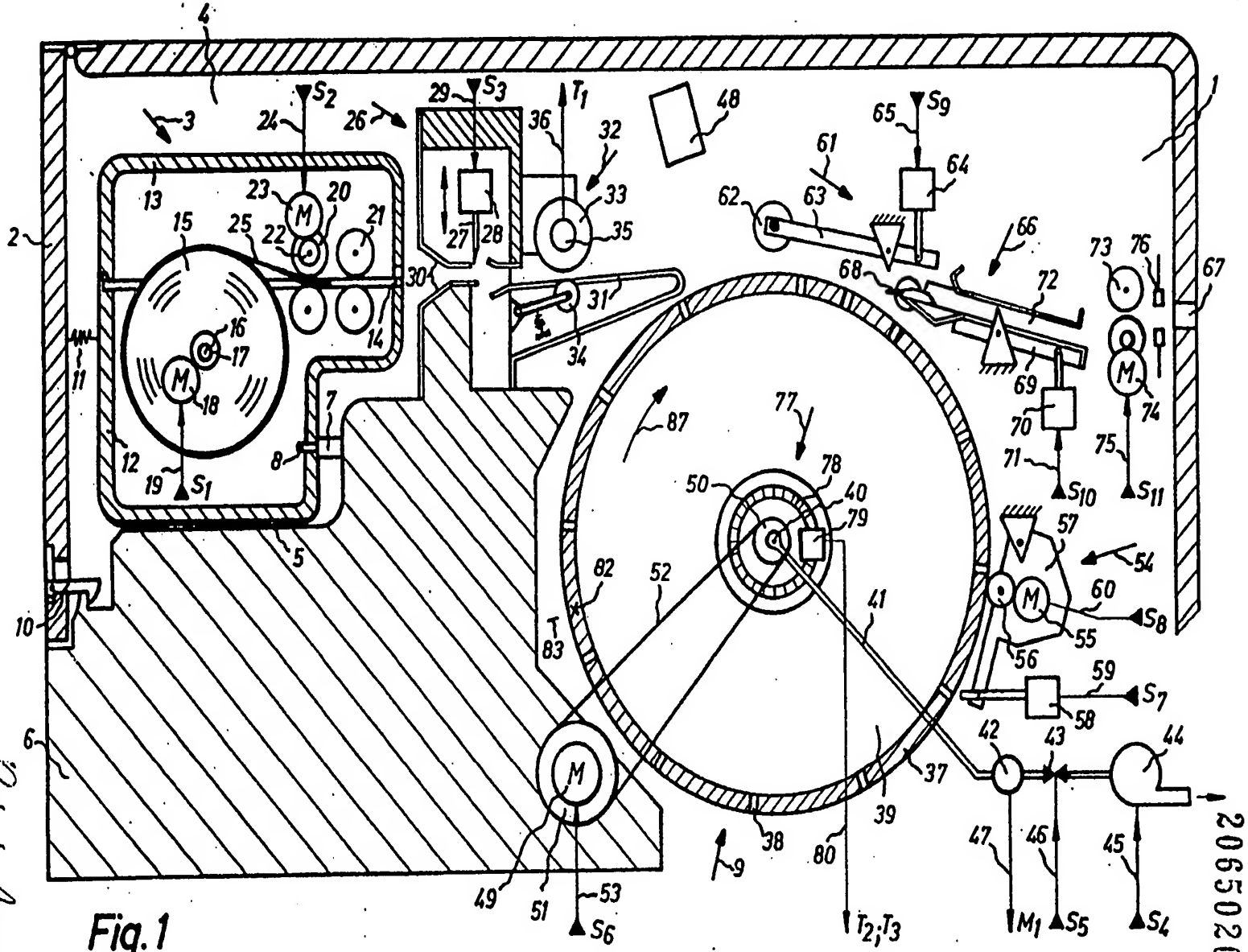
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Fig. 1
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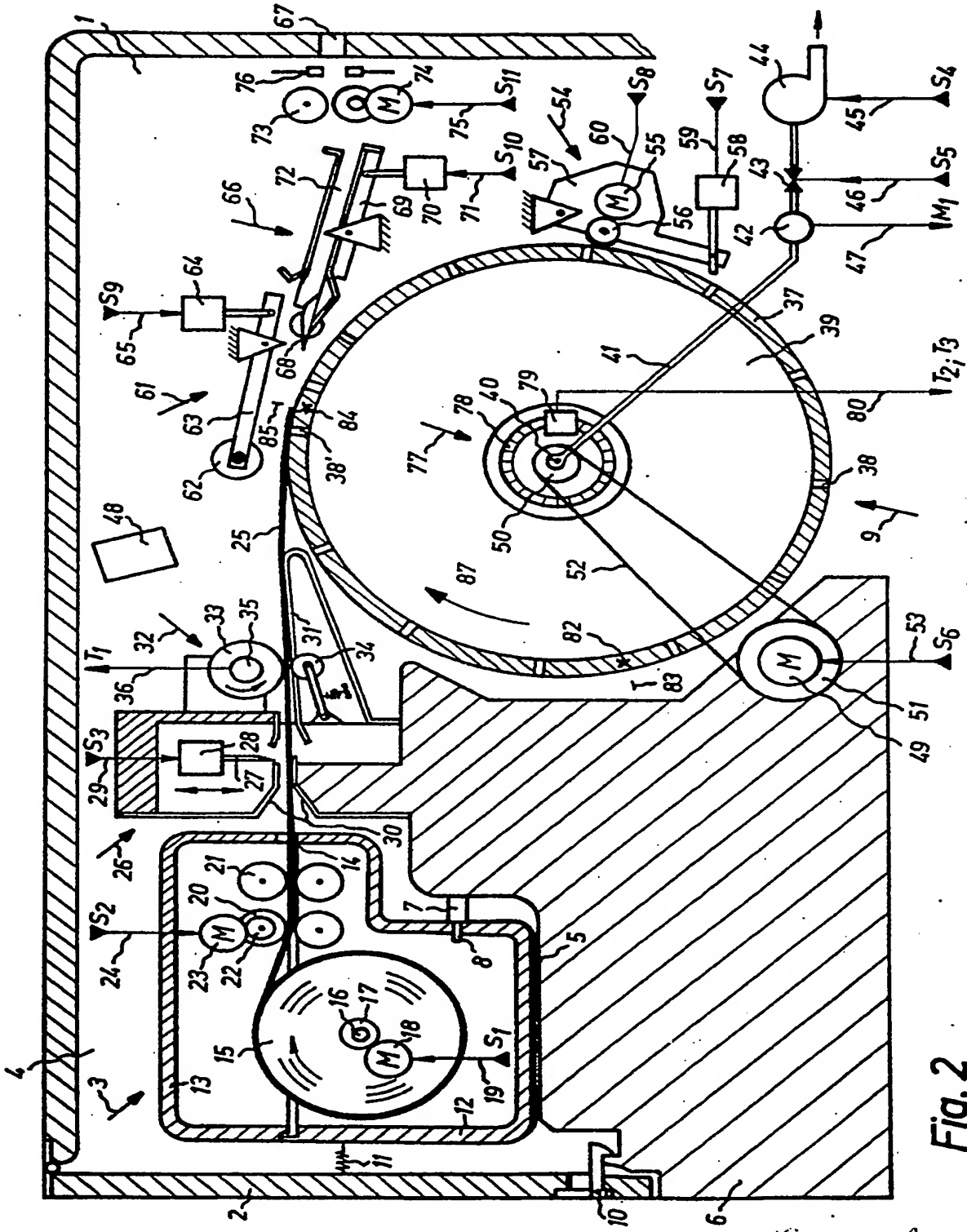

Fig. 2

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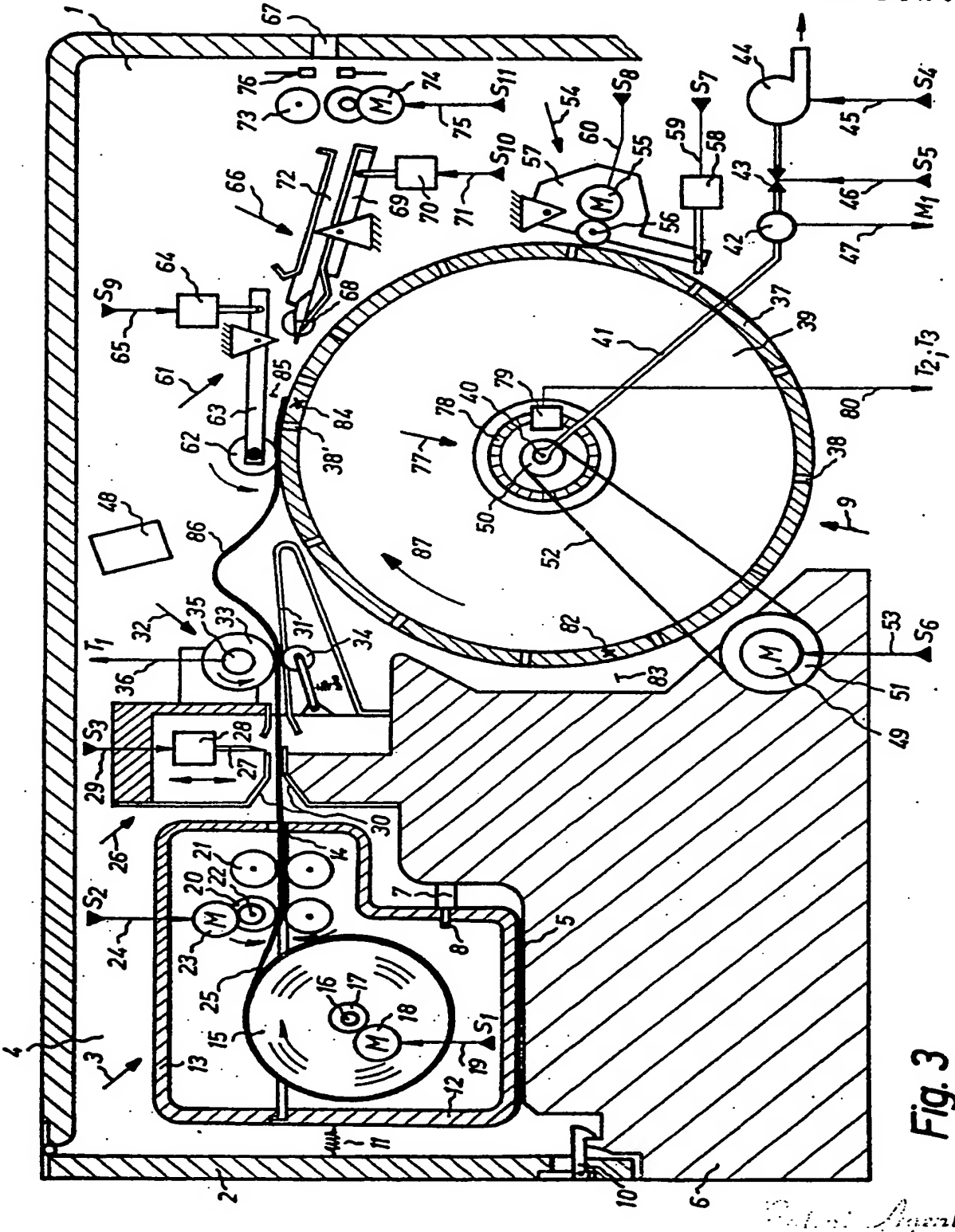

Fig. 3

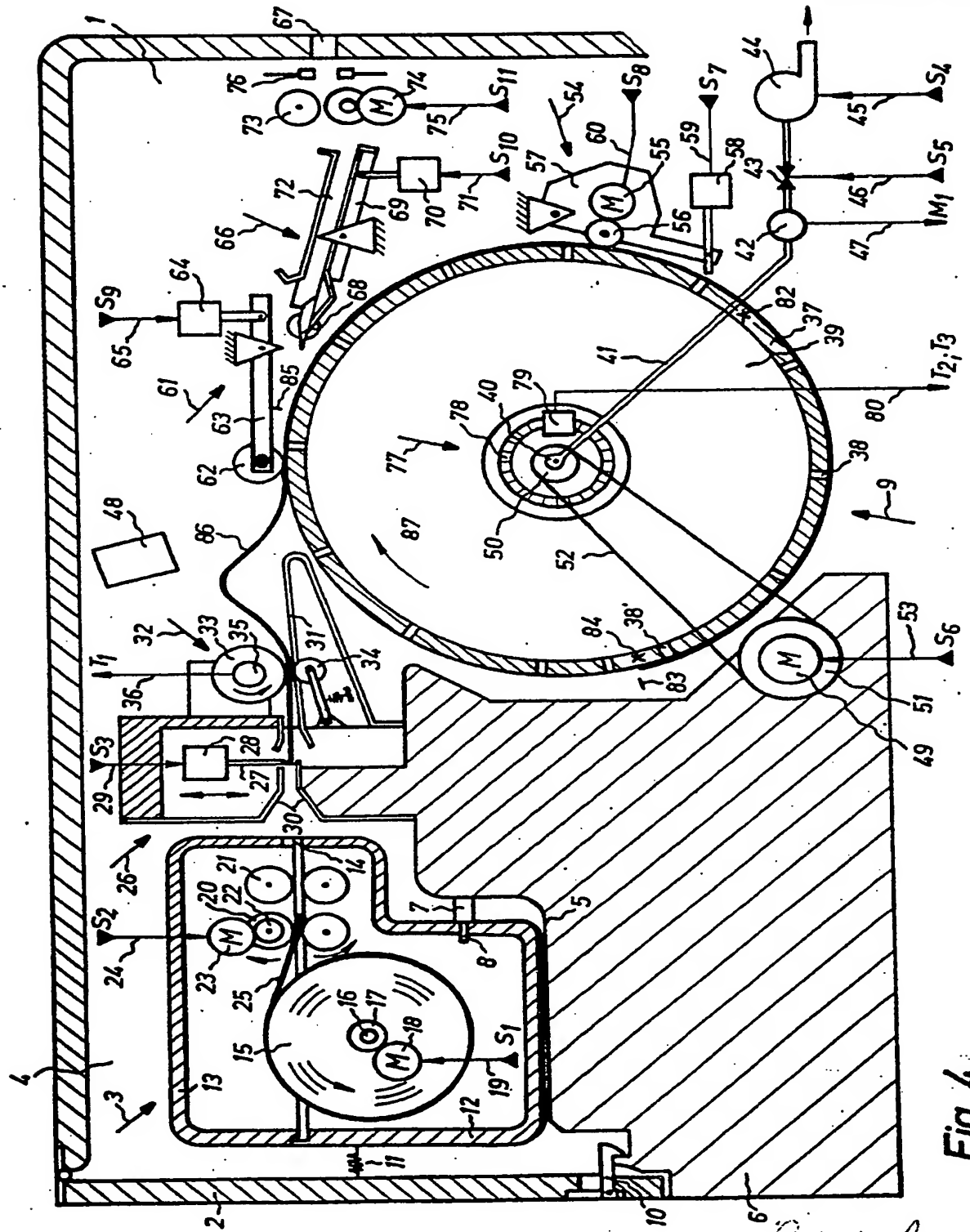

Fig. 4

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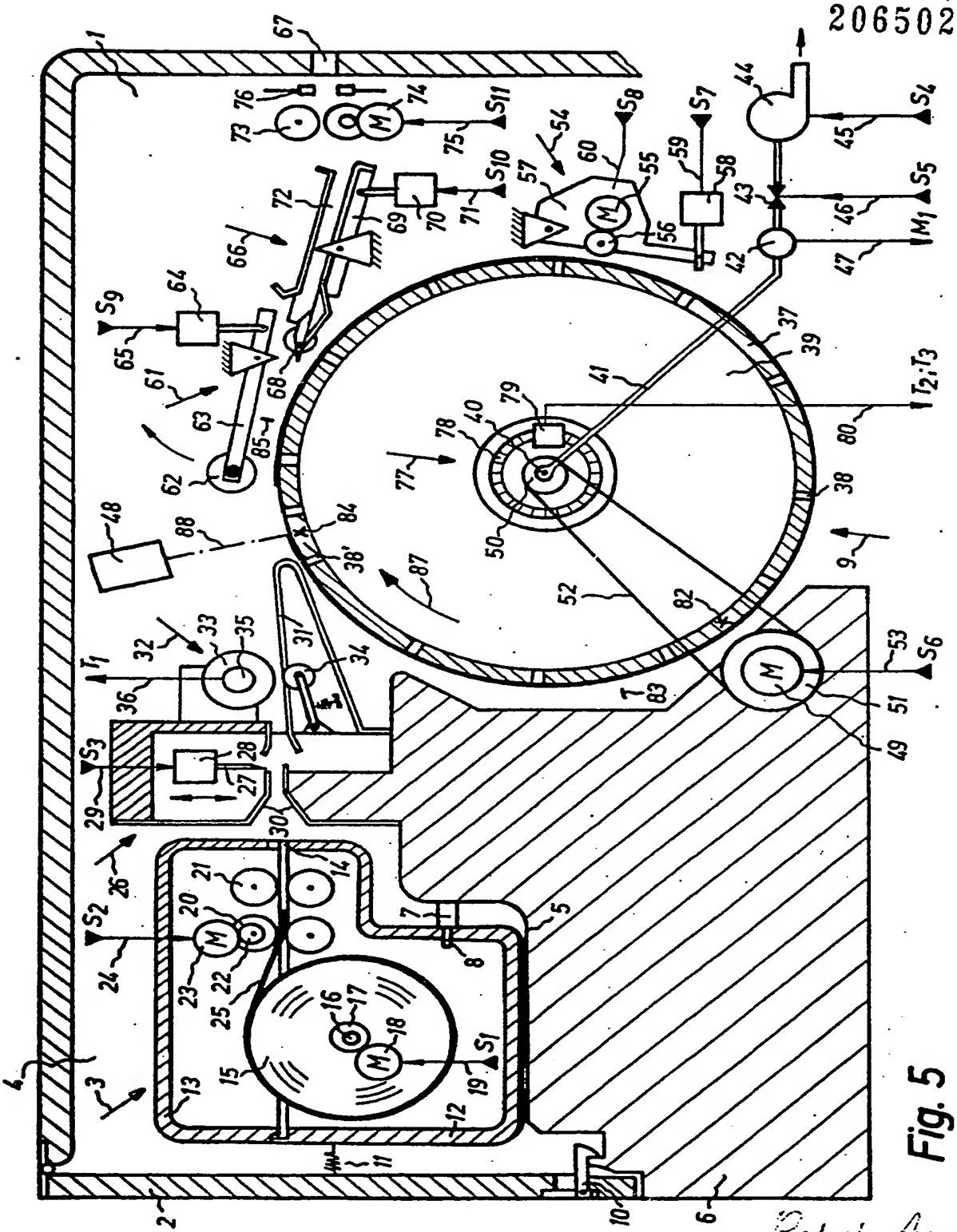

Fig. 5

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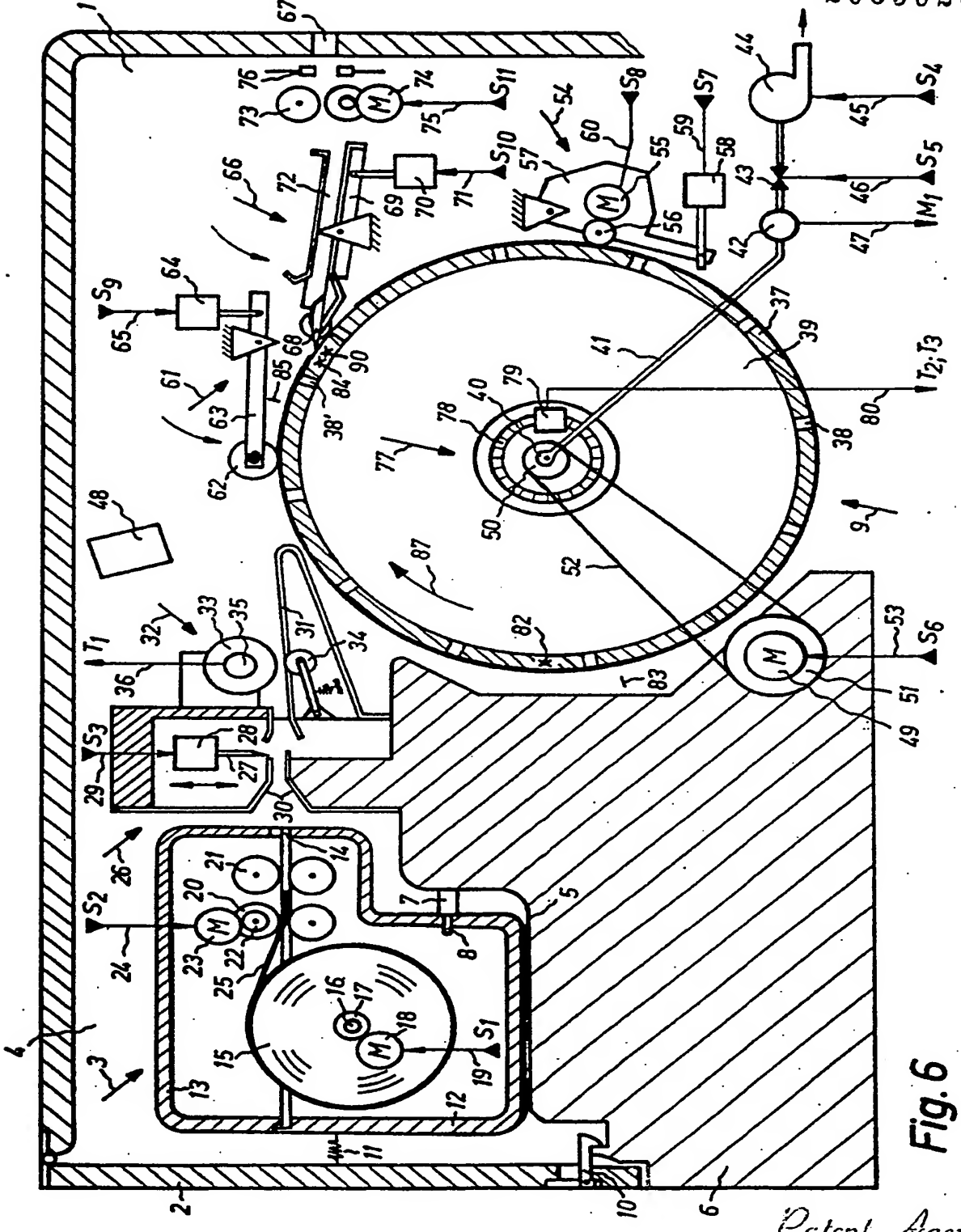

Fig.6

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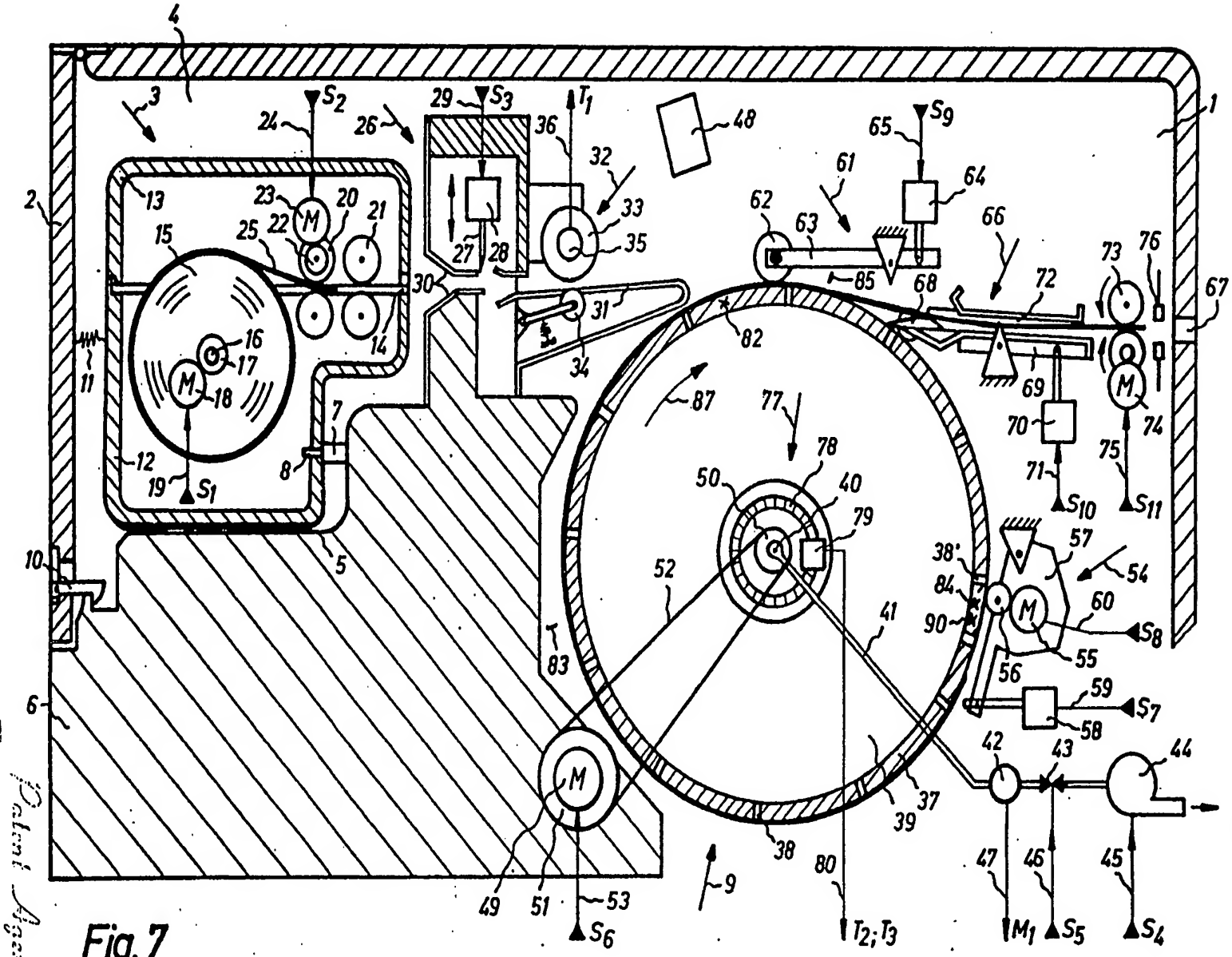

Fig. 7

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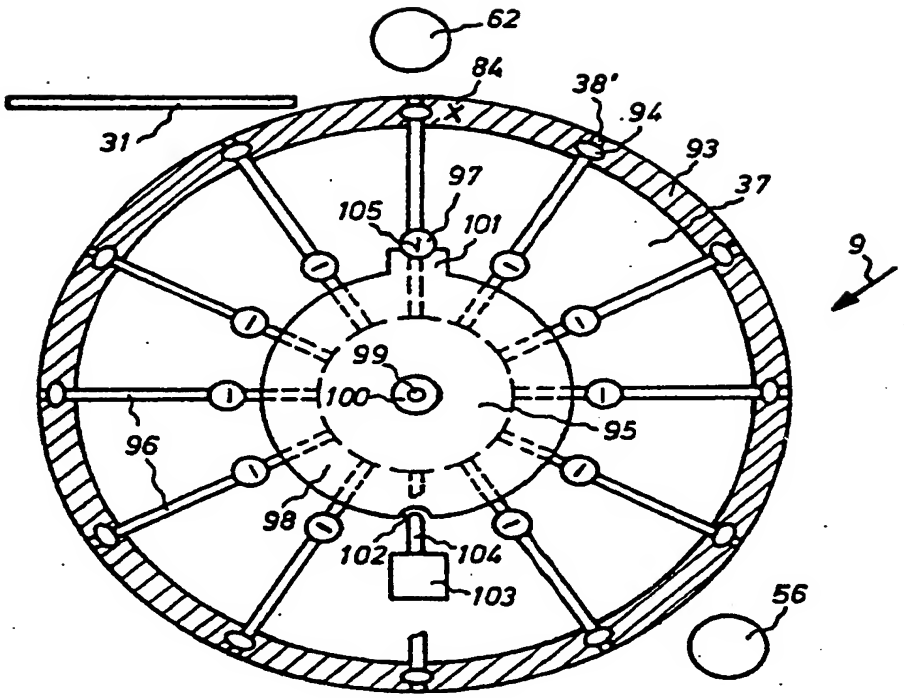

Fig. 8

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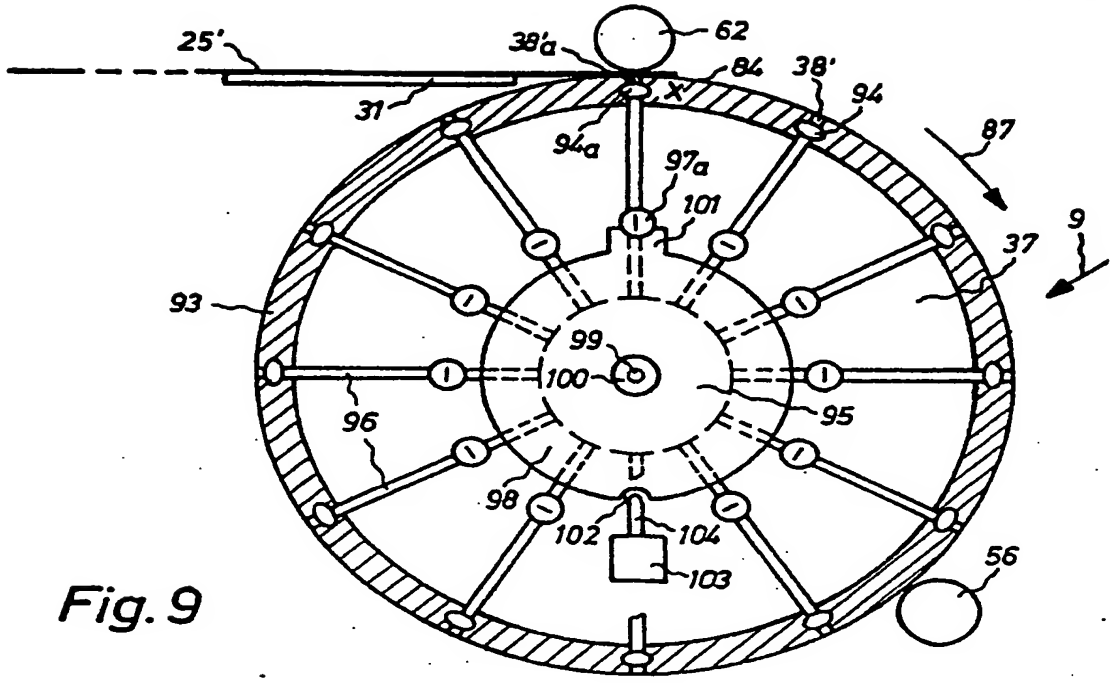

Fig. 9

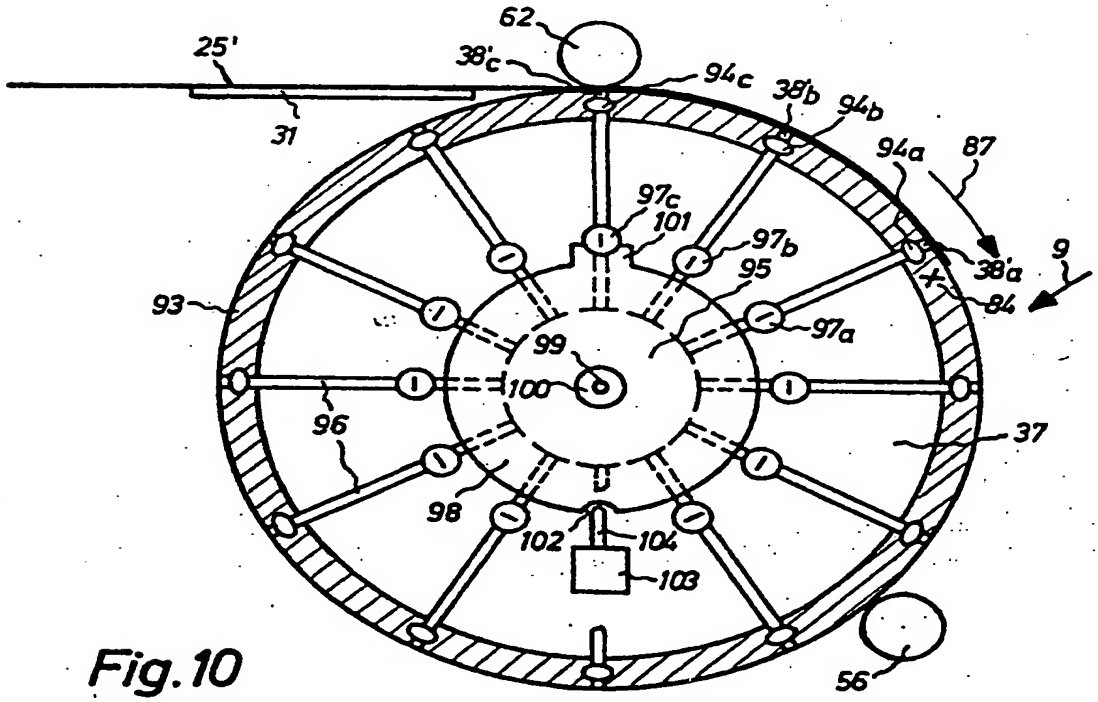

Fig. 10

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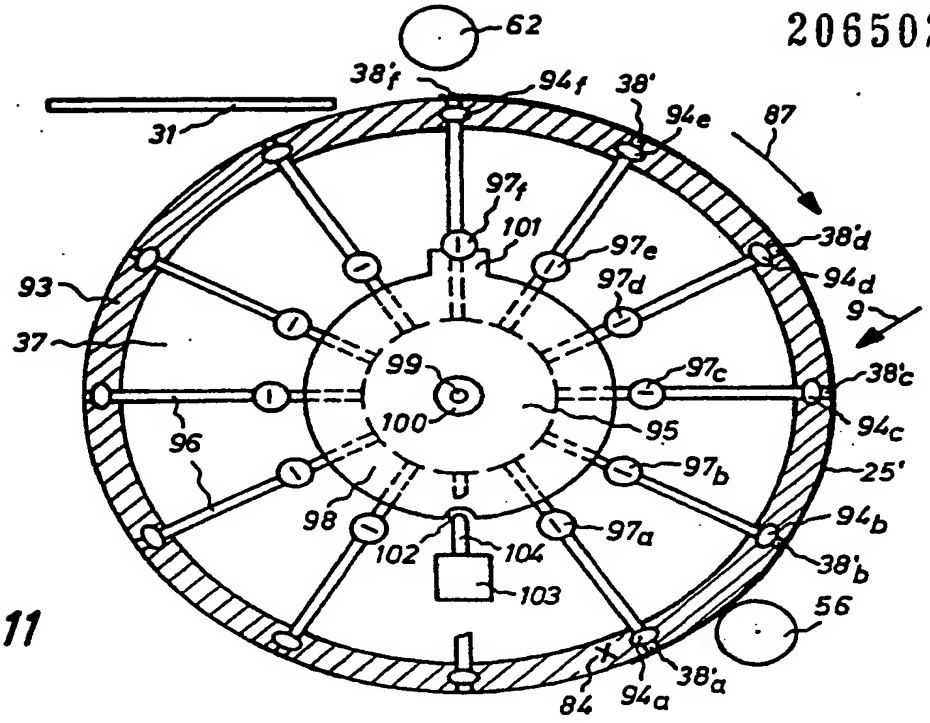

Fig. 11

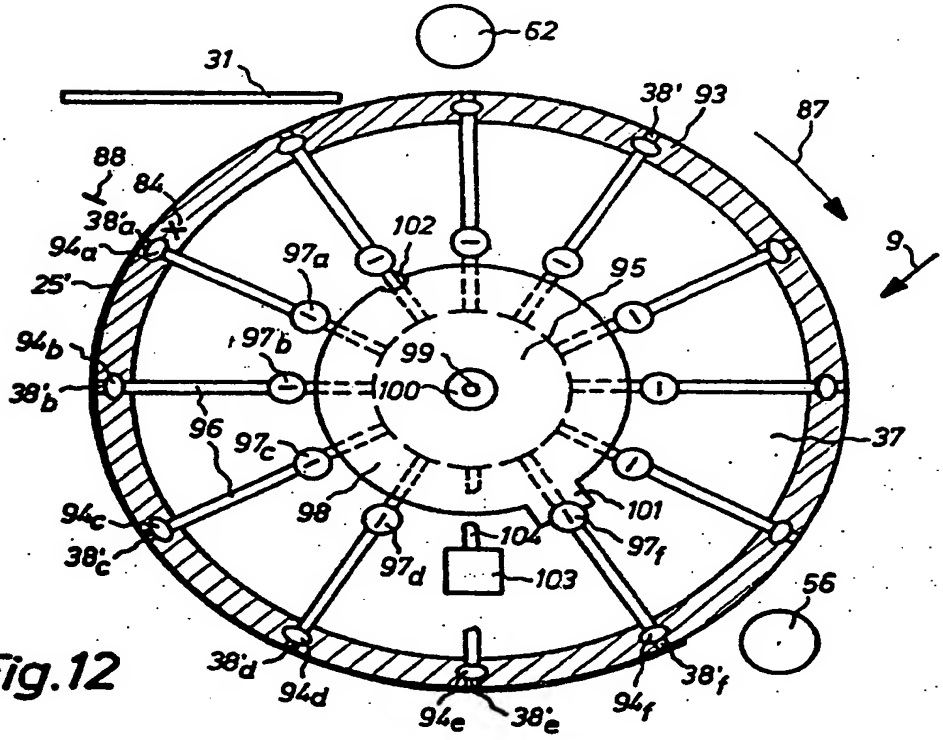

Fig.12

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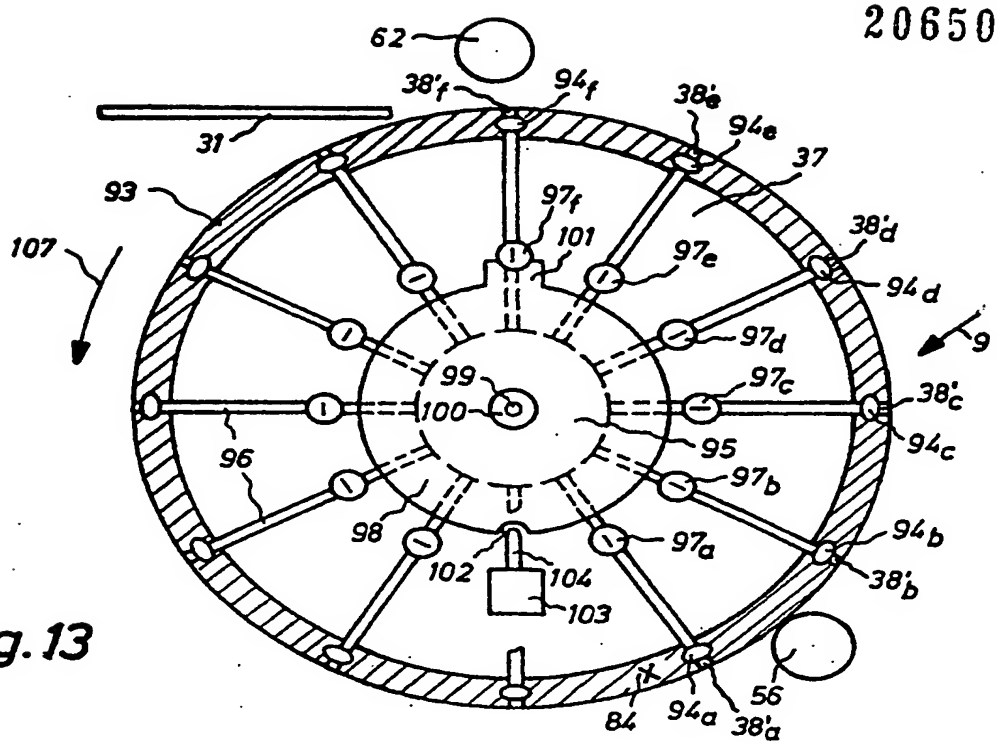

Fig. 13

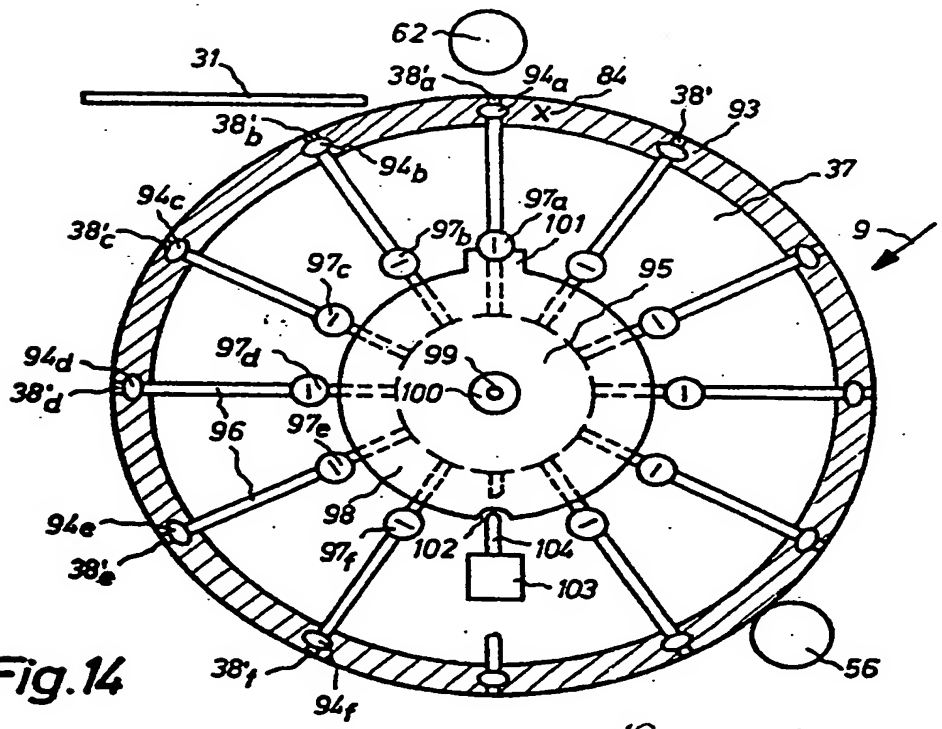

Fig. 14

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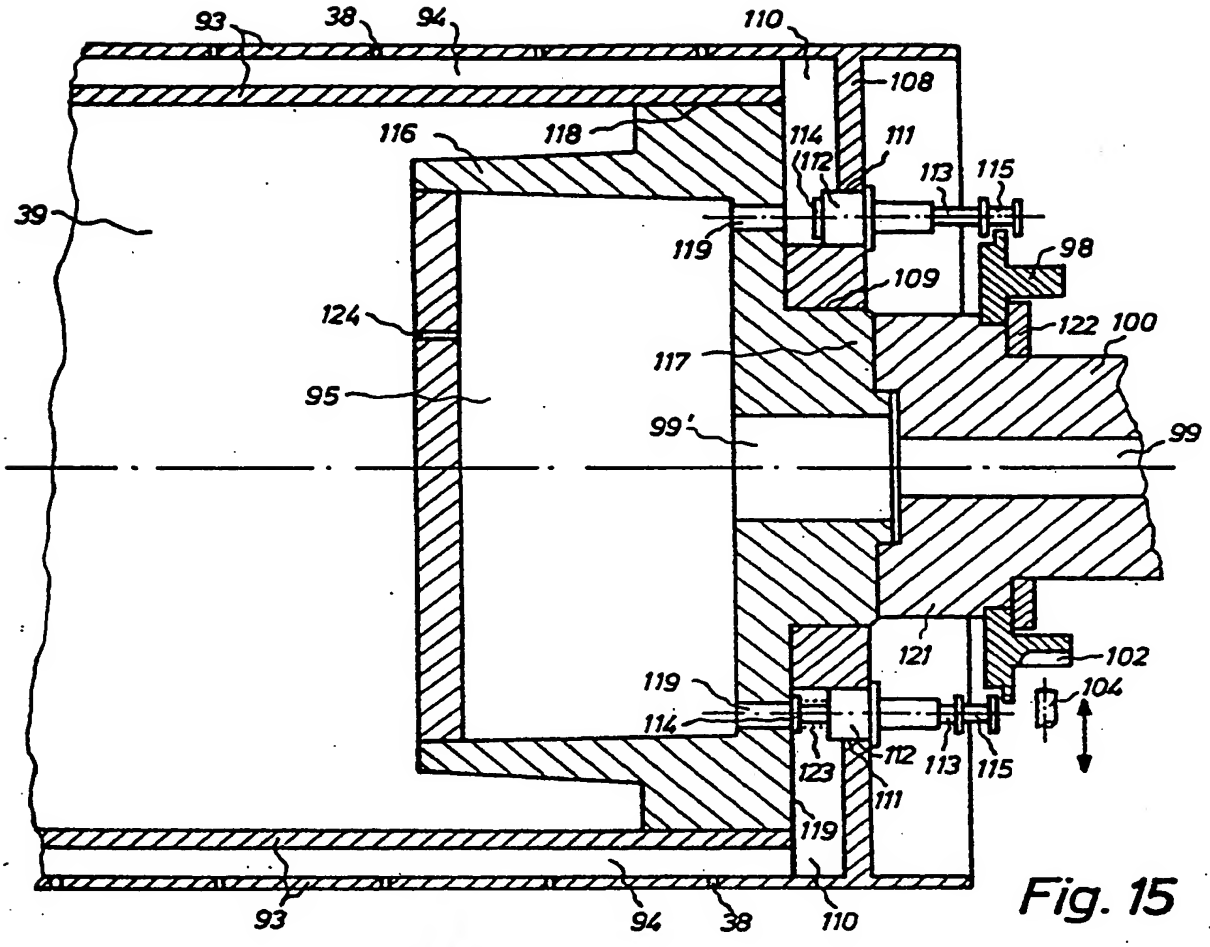

Fig. 15

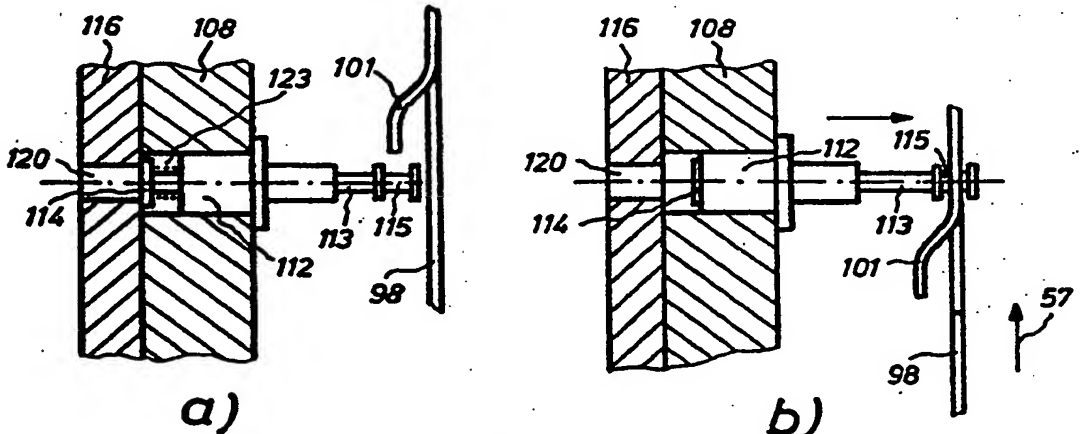

Fig. 16

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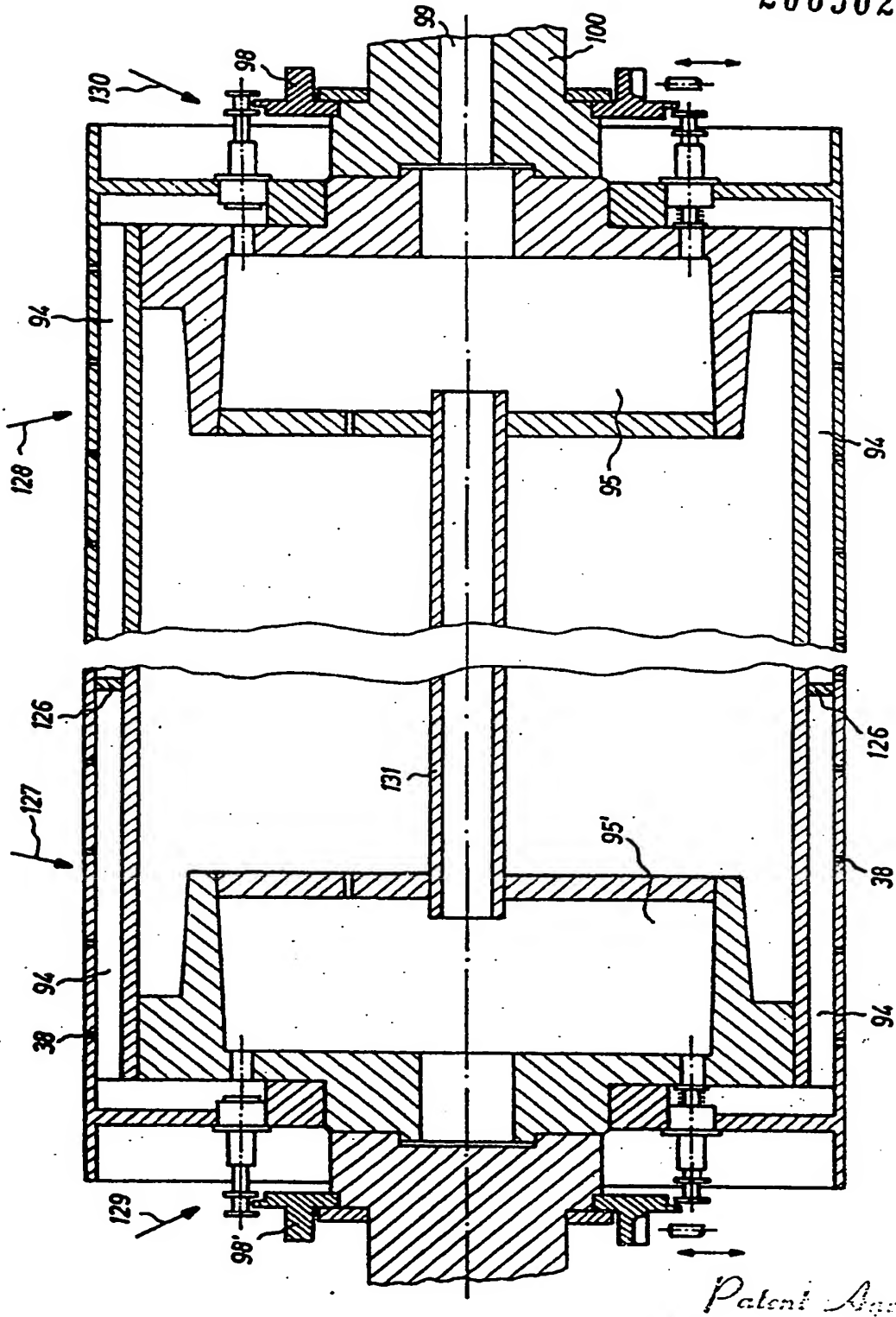

Fig. 17

Patent Agents

Docket # A-3835

Applic. #_____

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